THE MELHAGEN SITE:
A BESANT BISON KILL IN SOUTH CENTRAL SASKATCHEWAN

A Thesis
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ABSTRACT

The Melhagen Site (EgNn-1) is an early Late Prehistoric Period Besant bison pound. It is located in the Aiktow Sand Hills near the town of Elbow, in south central Saskatchewan. Excavations were carried out during the late 1960's by the Saskatoon Archaeological Society. Further excavations and surveys were conducted in 1986 and 1987. This thesis was undertaken to salvage the quickly deteriorating materials from the early excavations, and to further analyse and interpret the Besant occupations at the Melhagen site.

A discussion of past and contemporary views of the relationship between Besant and Sonota are supplemented by a statistical analysis of the Melhagen projectile point collection. The collection displays the complete range of variation in the size and shapes of points found in many Besant sites. Attributes identified in the statistical study relate to both the functional history and the stylistic variability of the points.

Several kill events occurred at the Melhagen pound. The most intensive hunting was concentrated in the fall, and several kill took place throughout the winter and into the early spring. The site displays evidence of primary, secondary and tertiary processing of carcasses. Interpretations regarding the Besant peoples' hunting strategies, bison processing and utilization preferences are developed through the examination of butchering patterns, paleoenvironmental, taphonomic, and ethnohistoric information.

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CHAPTER 1

Introduction and Research Goals

1.1) Introduction to the Melhagen Site (EgNn-1)

> "Few but Indians have seen this place, as it is in a neighbourhood too dangerous to be much visited" (The Earl of Southesk (1875: 75), after traversing the Aiktow Sand Hills towards the Elbow of the South Saskatchewan River).

The sand hills surrounding the Elbow of the South Saskatchewan River looked like a desert to early European travellers, but were significant to the Native peoples. Aiktow Creek flowed from a high spot in the sand hills towards the Elbow of the South Saskatchewan River, but during the spring floods would sometimes flow in the opposite direction into the Qu'Appelle River. A large glacial erratic known as Mistusinne was located near the Elbow, and was spiritually important to the Indians. The sand hills themselves provided refuge to a variety of game, waterfowl and the bison.

The construction of the Gardiner Dam in the 1960's flooded the Elbow of the South Saskatchewan River and Aiktow Creek. This resulted in the destruction of Mistusinne. There is little doubt that scores of other important archaeological sites were also destroyed.

The Melhagen site (EgNn-1) is a Besant bison kill site that is located within the Aiktow Sand Hills, approximately 18 kilometres east and 6 kilometres south of the town of Elbow, Sakatchewan

(Figures 1.1 and 1.2). The site is situated within pasture land that is owned by Agriculture Canada (Figure 1.3), and has been fenced off from the cattle since the 1960's. It was discovered by a group of hunters who noticed a large amount of bone eroding out of some small hillocks near a dugout. One of them, Mel Hagen, reported the site to a Saskatoon Archaeological Society (SAS) member, Keith Greene. He tested it and notified the president of Saskatoon Archaeological Society, Tom Phenix. Under his direction, the members of the SAS carried out excavations between 1967 and 1972 (Figure 1.4). A preliminary report was published in 1969 (Phenix 1969), but a full report was never prepared.

In 1986 and 1987, further excavations were conducted by this author (Figure 1.4). This thesis represents the culmination of both the Phenix and Ramsay research projects. It is estimated that less than 25% of the site has been excavated, and over 170 bison have been identified from the faunal collection.

1.2) Research Goals

Three major interpretive problem areas have been identified and will be addressed. The first problem involves the identification of the culture group that hunted at the Melhagen site. Conflicting definitions of Besant and Sonota cultures make it difficult to assign cultural affiliation to sites of this nature. The development of these definitions will be critically reviewed, and a comparative study of projectile points from other identified Besant and Sonota sites will demonstrate how these definitions lead to confusion in the identification of cultural affiliation. A statistical analysis of the Melhagen site projectile point collection will present a promising method for the development of more explicit diagnostic criteria in point assemblages.

The second problem area involves the determination of the frequency and seasonality of the site's occupation. It is important to know how many times the site was occupied, and during which season or seasons. This information is crucial as many of the remaining analyses and interpretations rely on its results. It will be addressed with data from the site stratigraphy, the analysis of bison mandibles, and three methods of gender analysis.

Once the frequency and seasonality of the site's occupation has been established, it will be possible to interpret the hunting, butchering and processing activities that took place. Paleoenvironmental and ethnohistorical information will be used to interpret hunting activities. Butchering and processing activities will be interpreted from ethnohistoric and archaeological references, as well as from patterns observed on bones and site activity area patterns.

The importance of this thesis lies in the fact that it makes available much of the unpublished information about the Melhagen site and supports this with a large body of new data. It deals with three problem areas which are critical to the proper interpretation of the site, and raises issues concerning archaeological definitions, methodology, theory and the limitations of archaeological data.

CHAPTER 2

The Physical Setting

2.1) Local Topography and Geography

The Melhagen site is located within the Aiktow Sand Hills southeast of Elbow, Saskatchewan (Figure 1.2). These sand hills have more recently been referred to as the Elbow Sand Hills by David (1977: 90-91). The landforms of this area consist of wind-worked glacio-fluvial and lacustrine plains. The land rolls gently with some occasional flat areas (Ellis *et al.* 1970: 77-78). Before the Gardiner Dam was constructed in 1967, the primary drainage channel was Aiktow Creek, which flowed northwest into the South Saskatchewan River. It is interesting to note that the word "Aiktow" translates into "The-river-that-turns" (Hind 1971*i*: 365) in the Cree language. This refers to the fact that the creek flowed west into the South Saskatchewan River most times of the year; however, when the latter river rose in the spring its waters flowed east (Eldon Johnson, personal communication 1989). The source springs for the Aiktow Creek and Qu'Appelle River were located at a point of high elevation 19 kilometres east of the Elbow (Hind 1971 *i*: 355). Aiktow Creek was flooded with the dam's construction, and is now part of the Gordon MacKenzie Arm of Lake Diefenbaker. Deer Run Creek, which flows intermittently, is presently the closest body of running water. Its source is located approximately 5.4 kilometres to the southeast of the site.

The farmland north and east of the sand hills area consists of unsorted glacial till plains exhibiting varying degrees of knob and kettle landforms. The interface between this area and the sand hills undulates gently. The soils are primarily medium to moderately fine textured moderately calcareous silty glacio-lacustrine deposits. There are patches within this area which contain more than 15% clay. As the sand hills approach Lake Diefenbaker, they become steeply sloping and rolling (Ellis *et al.* 1970: 77-78).

The soils of the Aiktow sand hills are dominantly Orthic Regosols. Generally speaking, the hilly areas have a higher fine sand content, while the more subdued landscapes have mixed and coarse sands. These Regosols are salinized. Because they are also highly permeable, surface and internal drainage is usually very high (Ellis *et al.* 1970: 77-78). Nevertheless, several alkaline sloughs of various sizes are present north of the site. In these spots the water table is very close to the surface, and glacial till is exposed. These slough areas do not drain well after heavy rains, and reach their maximum extent in the late summer (Hall 1987: 6).

The air photo of the sand hills in this area (Figure 1.3) shows that there are several stabilized parabolic dunes in this area, and that the prevalent wind direction is from the northwest. The site itself is located within a slight depression of a gently rolling area (Figure 1.4). Most of the site lies within a fenced area and is protected from cattle disturbance. It consists of at least five bone bed concentrations which are contained within small hillocks. Three of these lie close to the west fence line (Figure 1.5: Areas C, D and E) and one is south of the datum point (Area B). The remaining bone concentration does not lie within a discernable hillock, but is situated at the east fence (Area A) between a slight depression and a steep slope that runs up towards a dugout.

Eroded remnants of dune ridges surround the site on the north, east and south sides. The land north of the site is relatively flat for some distance, and becomes quite hummocky towards the northwest. Remnants of a medium-sized parabolic dune lie to the southeast of the site, and small and medium sized hills roll out to the east, west and south.

The original features to the east of the site were obliterated when the dugout was excavated, and some of the far eastern ridge may have been built up with backfill from the dugout. This ridge is stabilized with vegetation now. It is impossible to tell how much of this portion of the site was disturbed when the dugout was constructed and the water pump installed. The dugout itself contains less than a metre of water, which demarcates the maximum level of the water table. We were informed by people working for the PFRA that the water table was about five metres below the ground surface at the well (Hall 1987: 7-8).

2.2) Present-Day Climate, Vegetation and Fauna

2.2.1) Climate

This area lies within the semi-arid Middle Latitude Steppe Region. Although the Rocky Mountains prevent the eastward flow of moisture from the Pacific Ocean, precipitation results from cyclonic storms when cold dry air from the north interacts with moist warm air from the south. Winter temperatures range from the extreme of -46 °C to the summer extreme of 41 °C. The mean annual temperature is 2 °C (Scott 1971: 6). The mean temperature in January is -14 °C and 19 °C in July. The annual precipitation is 35.6

cm, 22.9 cm of which falls from May to September (Ellis *et al.* 1970: 16).

2.2.2) Vegetation

Extensive vegetation studies in some Saskatchewan sand hill complexes have been conducted, particularly in the Athabasca, the Dundurn and the Great Sand Hills. The latter two study areas are considered to be very similar to, and more representative of the Aiktow sand hills. The most notable studies are those done by Hulett *et al.* (1966), and Townley-Smith (1980a; 1980b).

A transect survey of the vegetation on the Melhagen site was completed in 1986, and the following discussion is taken from a report compiled by Deck (1988).

a) Methodology

A line intercept sampling technique (Smith 1974) was used to survey the vegetation within the fenced off excavation area in August 1986. Five transects were randomly laid out by placing a metre tape along the grid established for excavation. The length of each transect varied, ranging from 23.6 metres to 51.6 metres, depending on distance to the fence. The transects were divided into intervals of one metre, and every third metre was sampled. The plant species along each interval were recorded by measuring the total distance of cover (cm). Frequency was calculated by counting the number of units a species occurred within a transect divided by the total number of units within a transect. Voucher specimens were collected for identification in the lab.

These data were interpreted by calculating importance values (Table 2.1). An importance value is a synthetic figure, the sum of relative cover and relative frequency. Relative cover is the total distance a species covers in all the transects divided by the total length of the transects. Relative frequency is the total number of units a species occurs in divided by the total number of units of all the transects. Test pits or back dirt piles that crossed the transects were omitted from the final calculations.

b) Results

Twenty-eight plant species plus several unidentified grasses occurred along the five transects (Table 2.1). Another 13 species (Table 2.2) were noted in the immediate vicinity, making a total of at least 41 species. There were 9 grasses identified, 11 members of the daisy (Compositae) family, three legumes (Leguminosae), two mustards (Cruciferae) and two members of the rose (Roaceae) family. Eleven other families were represented by one species each.

The vegetation is a mosaic of patches of low shrubs in a matrix of prairie grasses and forbs. Together they provide almost complete ground cover as only 4% of bare ground and litter was recorded. Five shrub species make up this mosaic, the dominant being wolfberry (*Symphoricarpos occidentalis*) with the highest importance value of 54 out of a maximum of 200 (Table 2.1). Wolfberry patches were widely distributed along the transects as illustrated by its frequency of 23%. Juniper (*Juniperus horizontalis*) was the next most important shrub but its importance value (21) was less than half that of wolfberry. Junipers occurred in widely-spaced patches with a frequency of only 5%. Wild rose (*Rosa* sp.), wolf-willow or silverberry (*Eleaegnus commutata*) and bearberry

(*Arctostaphylos uva-ursi*), a woody ground-hugging perennial were all of minor importance (Table 2.1).

In the herbaceous layer grasses had a collective importance value of 77. Among the grasses were those typical of short grass prairie habitats including *Agropyron trachycaulum* (slender wheat grass), *Stipa comata* (spear grass), *Elymus canadense* (nodding wild rye), *Koeleria cristata* (june grass) and *Sporobolus cryptandrus* (sand dropseed). Sedges were rare, with an importance value of only four. The herbaceous forbs were a minor and infrequent group. The daisy family had eight species making up an importance value of 13. Golden hairy aster (*Chrysopsis villosa*) was the most important of these with a value of five. No other species had an importance value of more than three and most were less than one.

The vegetation appeared relatively undisturbed with only four introduced species. They were a minor component having a collective importance value of four. Dandelion (*Taraxacum officinale*) and tansy mustard (*Desculania sophia*) were recorded in the transects. Russian thistle (*Salsola kali*) and brome grass (*Bromus inermis*) were in the general area.

The dense cover of vegetation serves to stabilize the dunes, although nearby areas have been active within recent memory. At least 21 plants (Table 2.3) have recorded uses (Hellson and Gadd 1974; Johnston 1982). Those used for food include the berries of wolfberry, bearberry, and rose hips.

Most of the species noted by Deck (1988) can also be found in either, or both of the other sand hill complexes. The exceptions are *Aster laevis*, (smooth aster), *Taraxaum officinale* (dandelion) and

Glycyrrhiza lepidota (wild licorice). Many plants, especially the grasses and forbs, enjoy a wide distribution across the prairies in both moist and arid environments (Budd and Best 1969). Species which seem to do well in sand hills or arid conditions include *Juniperus horizontalis* (juniper), various *Rosa* (rose) species, *Elymus candense* (nodding wild rye), *Sporolobus cyrptandrus* (sand dropseed), *Crysopsis villosa* (hairy golden aster), and *Psoralea lanceolota* (lance-leaved psoralea) The only introduced species is *Taraxacum officinale*, which is better known as the dandelion. It is also well known to have a wide distribution. Some species found at the site are considered to be good indicators of overgrazing, such as *Eleagnus commutata* (silverberry, wolf-willow) *Artemesia frigida* (pasture sage) and *Psoralea lanceolota* (lance-leaved psoralea). The latter of these is often found in blow-outs and serves to stabilize active dunes (Budd and Best 1969).

Since this area is currently used as cattle pasture, and are inhabited by a number of grazing and browsing animals, it is not surprising that such species exist here. The vegetation cover is quite obviously affected by the cattle, and is especially notable when early photographs of the Melhagen site are compared to recent ones (Figures 1.6 and 1.7). Indeed, erosion precipitated by cattle traffic is what led to the exposure of the site in the first place. Cycles of erosion and stabilization have probably occurred here since the site was formed. Had the site not been fenced off, it would have certainly been destroyed by now.

2.2.3) Fauna

The present-day faunal inhabitants of the sand hills are well-adapted to grassland and parkland environments. During our stay at the site, we noted that the domestic cattle shared their habitat with mule deer, white-tailed deer, and a few antelope. Smaller mammals included a variety of rabbits, mice, gophers and ground squirrels. Coyotes were abundant and noisy, and an old mountain lion was reported to be in the area in 1986. Local mustelids include the ermine and the least weasel (Richards and Fung 1969: 81). Several tiger salamanders and toads were found at the site, and were probably occupants of the adjacent dugout. Many bird species are also present. In particular we noted red-tailed hawks, blue herons, ducks, and at least two species of owls. Smaller songbirds are too numerous to mention in detail, but sparrows and meadowlarks were plentiful.

2.3) The Paleoenvironmental Setting

The events which took place at the Melhagen site cannot be properly interpreted unless aspects of the physical environment during the site occupation are understood. Climatic conditions and ancient landscape features are especially important to this discussion, and are also related to those factors which have affected the archaeological data itself.

2.3.1) Paleoclimate

The Besant time period overlaps two climatic episodes. The Sub-Atlantic climatic episode (2890 B.P. to 1690 B.P) was much wetter than today's climate: summers were moister and cloudier, while winters were stormier (Hoffman and Jones 1970: 361). From

1690 B:P to 1100 B.P., the Scandic period brought in warmer and drier conditions.

The moist conditions of the Sub-Atlantic would have led to a higher water table at the Melhagen site. Vegetation may have also become fairly thick and lush, making the sand hills more attractive to bison herds. Severe winters during this time would have also made the shelter of the sand hills attractive, for bison and humans alike. The more arid conditions of the Scandic period probably led to more frequent droughts and episodes of erosion.

2.3.2) Site Stratigraphy

a) Objectives

Careful stratigraphic analysis is often a critical portion of the interpretation of an archaeological site, especially in those sites which were occupied by successive groups of people. The objectives of this section are first, to describe the stratigraphy at the Melhagen site. It will be demonstrated that this evidence is not very informative in the interpretation of multiple occupations at the Melhagen site. Second, it explains what processes account for this situation.

b) Methodology

The best stratigraphic information comes from the author's field work because the Phenix records lack detailed descriptions. This is not a serious problem, however, because all of the areas excavated by the author demonstrated similar patterns of stratigraphy. It is unlikely that the Phenix excavation areas were significantly different.

Trench-style excavations (described in Chapter 4) enabled the author to get a good idea of the patterns of the stratigraphic profiles across the site. A profile of each unit was drawn by hand on a prepared form and photographs were also taken of the units where possible. The soil profiles are provided in Figures 2.1 to 2.9.

c) Analysis and Results

The vegetation cover over the sand hills has stabilized sand movement in the area. This has produced a sod layer that reaches an average depth of 10 cm. Testing and excavations showed that several bone beds were located within small hillocks across the site. Under the sod in each small hillock, an aeolian sand layer (Level 1 in Figures 2.1 to 2.9) varied in thickness from about 10 cm to over a metre. Below this sand lay the single bone bed (Level 2). The bone bed was thickest towards the center of the hillock (about 30 to 50 cm) and became relatively thin at the margins (five to 10 cm). . The soil in the bone layer still consisted of sand, but was nearly black in colour due to its high organic content.

The interface between the overlying aeolian sand and the bone bed exhibited distinct evidence of loadcasting and/or possible animal trampling. This was seen in the undulating bone bed surface, and in the presence of "flame" structures in the soil (Figure 2.5). The processes which account for this will be described more thoroughly in section 2.4. The loadcasting and trampling would have mixed the contents of the bone bed somewhat, and obscured any evidence of discrete multiple occupations.

Bone and artifacts were so densely concentrated in the upper two-thirds of the bone layer that excavations were primarily done with trowels and fine tools. The lower third of the bone layer, or at least the last five cm generally held few bones or artifacts, and could easily be removed by shovel-shaving. An occasional thin lense of alkaline soil was sometimes apparent in the lower half or lower third of the bone bed. These lenses often were not easily seen when excavators actually exposed them, but were much more visible in the vertical soil profile.

The interface between the bottom of the bone bed and the sandy substratum showed evidence of leaching in most places. The substratum (Level 3) itself consisted of a coarser sand than Level 1, and was sometimes heavily mottled with orange oxidized spots of sand, especially in the excavations on the eastern side of the site. This is indicative of a high water table. Phenix (personal communication 1986) had apparently excavated to a depth of approximately six feet (or roughly two metres) below the bone bed in Area D with an auger, and found no evidence of deeper, earlier occupations at the site.

The pattern of stratigraphy in the eastern excavations (Figures 2.1 to 2.2) departed slightly from the general pattern found elsewhere across the site, especially in the bone layer itself. It was slightly thinner on average (20-30 cm) and the bone had been fragmented by natural processes such as water saturation, freeze-thaw cycles and root damage. The soil of the bone bed was much more alkaline in appearance than in other areas of excavation. Bones recovered were coated in a greasy layer of alkaline material that was difficult to remove in the lab.

In general, the stratigraphy at the Melhagen site is quite similar to that of the Muhlbach site (Gruhn 1971:133-135), which is also located in an area of low sand hills. The soil profiles of the Muhlbach site show that the upper surface of the bone bed undulates, so it is quite possible that trampling or loadcasting were important postdepositional processes there too. It shares a number of other similar features with the Melhagen site as well. The Muhlbach site also has an underlying layer of sand with oxidized deposits, a black sandy bone bed with greasy soil, and an overlying aeolian deposit of sand. In all, it seems that the nature of the present and paleoenvironmental conditions of the Muhlbach site make it the most comparable to the Melhagen site.

d) Summary of the Stratigraphy

Excavations across the site revealed several hillocks consisting of one bone bed layer. None of the bone bed areas demonstrate any evidence of multiple occupations at the site in their vertical profile. The loadcasting and/or trampling demonstrate that the bone bed was once quite muddy, and has been altered by these processes, which would have mixed any layers that did exist and obliterated stratigraphic separation between layers.

2.3.3) Flotation Study

a) Introduction to the Flotation Study

The analysis of paleobotanical remains found in archaeological soil samples has resulted in some important achievements in paleo-ecological studies throughout the world (Bryant and Holloway 1983; Butzer 1969, 1971; Dimbleby 1985; Shackley 1981). These studies have aided in the interpretations of past climatic shifts, human effects on the natural biome, the development of agriculture, prehistoric diet, graveside rituals, intersite and intrasite dating.

A flotation study was conducted with soil samples from the Melhagen site so that comparisons could be made between the present-day vegetation and ancient vegetation patterns. As this section will show, no useful paleobotanical information was produced, but the flotation analysis did produce a good sample of snail shells, snail eggs and ostracods. These are important in the discussion of the Melhagen site paleoenvironment. Much of the following comes from Hall (1988), while the actual analysis is drawn from a report prepared by Deck (1988).

Paleobotanical studies are subject to a number of potential hazards. One of the most important of these is the degree of preservation. Generally, preservation is better in acid soils than in base-rich soils (Dimbleby 1985: 18). At the Melhagen site, there was a definite alkaline layer below the bone bed in some areas, and lenses of alkaline within the bed in other areas. This indicated that the preservation of ancient vegetation would be poor. This proved to be the case.

Another potential problem lies in the assumption of the paleobotantist that charred seeds and pollen grains were culturally-modified, while the uncharred remains represent non-cultural agents of deposition. It may be argued that natural fires may occur with some regularity, especially in semi-arid regions such as the sand hills. In fact, one major grass fire caused by a lightning strike burned a large portion of the Aiktow Sand Hills in the summer of 1989. Thus the charring of seeds need not be indicative of human activity.

Conversely, people carry out many activities, especially at a bison kill, that do not include the burning of seeds. Thus, many uncharred seeds may have been incorporated into the cultural horizon at the time that the site was deposited (Deck, personal communication 1988). There are many other problems which may have resulted in the contamination of the soil samples used for the pollen. These involve on-site sampling procedures, the processing of the samples, root and bioturbation. These will be discussed later.

b) Flotation Study Methodology

The flotation procedure was designed to extract seeds and other residue from soil samples taken across the site. Ten soil samples were collected, constituting 148 litres of soil (Table 2.4). Six of these were from the cultural layer (Level 2) and four control samples were taken from both Level 1 and Level 3 above and below the cultural level. The contents of the samples are summarized in Tables 2.5 and 2.6.

The samples were floated in the fall of 1986 at the University of Manitoba using a flotation machine. It operates on a system of air and water causing botanical remains such as seeds and charcoal to float (Deck 1988: 4). Prior to flotation, the buoyancy was increased by soaking the soil samples in buckets of water with a dispersant (sodium hexametaphosphate or commercial calgon), and a frothing agent (MIBC). A collector (kerosene) was added to the water in the flotation barrel. The residue produced consisted of a heavy and a light fraction. The heavy fraction consists of those materials that do not float and which are caught in a 1.6 mm sieve. The light fraction consists of those materials which float, and which were poured into a stack of six geological sieves (4.00 mm, 2.00 mm, 1.00 mm, 0.50 mm, 0.35 mm and 0.25 mm inclusive). The samples were then put onto drying racks (Deck 1988: 4).

Once the samples had dried, each fraction from a sample was resieved through the same size grades mentioned above. They were then weighed. Some of the larger or richer samples were subsampled using a sample splitter (Schaaf 1981). Materials were sorted and identified under 50X magnification with reference to books and seed collections in the Anthropology lab and the Herbarium at the University of Manitoba (Deck 1988: 4).

Artifacts, bones, charcoal, charred and uncharred seeds, and shell were separated from the heavy, the 4.00 mm, and the 2.00 mm fractions. Seeds, shell and charcoal were sorted from the remaining smaller fractions. Each material was put in a separate vial according to fraction size (Deck 1988: 5).

A correction factor was calculated for fractions that were subsampled. This is the fraction weight divided by the subsample weight. Seed density for these fractions could then be calculated by multiplying the total number of seeds found in a subsample by the correction factor. The number of estimated seeds per litre was calculated for each sample by dividing the estimated number of seeds by the sample volume (Deck 1988: 5).

c) Analysis and Results of the Flotation Study

Seeds

Nine of the ten samples contained seeds totalling 3796 of which 99.7% were uncharred. The uncharred seeds are probably recent and represent the natural seed bank of the soil (Archibald and Hume 1983). Among these are *Chenopodium, Polygonum, Rosa, Lappula echinata, Lychnis, Descurainia, Axris amaranthoides,* and members of the Compositae and Gramineae families (Deck 1988: 8).

Chenopodium (Goosefoot) was the most abundant and was distributed in every sample. It is an introduced species and is common in waste places (Budd and Best 1969: 176-178). *Polygonum* (Knotweed) has several varieties, some of which are introduced from Europe, and others that are native to different geographical and environmental areas (Budd and Best 1969: 158-170). *Lappula echinata* (Bluebur) is an introduced European weed species (Scoggan 1979) and is common in cultivated fields and overgrazed pastures (Budd and Best 1969: 363-364). It was discovered in the cultural level and may indicate sample contamination or post depositional processes such as bioturbation. *Axris amaranthoides* is also an introduced species. Berry pomes from the Rosaceae family (likely *Rosa, Crataequs,* or *Amelanchier*) were discovered in three samples. More seeds were found in the control samples than the cultural samples. There were few charred seeds (0.3%), all of which were unidentifiable due to poor preservation and severe charring, except for one that compared with *Potentilla arguta* (White Cinquefoil). *Potentialla* is common in moist places, slough margins and throughout much of the prairie (Budd and Best: 1969: 247).

Seed density was estimated for each sample. This ranged from no seeds to 309 seeds per litre. Both of these extremes were from control samples. The average estimated number of seeds per litre from all 10 samples is 35 (Deck 1988: 11).

Charcoal

There were only a few tiny fragments of charcoal remains which weighed a total of 1.12 grams. These appear to be mostly partially charred root or twigs. Several pieces of diffuse porous wood were identified, and they may represent species from the aspen groves (Deck 1988: 11).

Shell

At least four families of gastropods totalling 1012 individuals were found in the samples. Numerous shell fragments and possible snail eggs were also present. The majority of the shell was located within the cultural samples. A type of crustacean, Ostracoda was found only in the cultural level. This is a tiny organism that lives in water (Deck 1988:11-12).

The gastropod shells were sorted into the four family groups by Deck. These were then identified by Dr. U.T. Hammer in the Biology Department at the University of Saskatchewan. Group 1 consisted of the family Planorbidae, (*Armiger crista L.*). These gastropods live in ponds in depths that range from 10 cm to two metres (Pennak 1989: 553). Type 2 shells belonged to the family Hydrobiidae, and possibly represented *Amnicola walkeri* . The Type 3 shells were identified as members of the family

Lymnaeidae, (*Lymnaea*). Many of these were quite small, which led Hammer (personal communication, 1990) to assert that the slough had dried up before they became fully mature. The Type 4 group belonged to the family Valvatidae (*Valvata* ?). Some species were difficult to identify because the opercula (the lids for the shells) were absent.

Little information is available for most of these species. Generally speaking, however, gastropods usually reproduce sexually. Oviposition occurs in the spring and continues for most of that season. The lifespan of most gastropods lasts between nine and 15 months, although some Lymnaeidae have been known to live for three or four years (Pennak 1989: 552).

The amount of dissolved salts in the water is extremely important to gastropods, and calcium carbonate is most important because it is essential for shell construction. Soft waters have few species and individuals, while hard waters contain many species and individuals (Pennak 1989: 552-554). For example, the Lymnaeidae generally occur in waters that are high in carbonates (over 15 ppm of $C0_2$). The pH (hydrogen ion concentration) is associated with and is partly determined by the $C0_2$ content. Those waters which are high in carbonates are almost always alkaline. Therefore, most species and individuals of gastropods can be found in alkaline waters (Pennak 1989: 554). For example, the Lymnaeidae are confined to waters where the pH is 7.0 or more. Snails are uncommon where the ph of surface waters is more than 6.2.

Dissolved oxygen is also important. Most species require lots of oxygen, so polluted rivers and deep lakes are often devoid of gastropods. Most gastropods occur in shallow waters less than three metres deep. Food is also more abundant at such depths (Pennak 1989: 554). In those ponds that dry up for short periods in the summer and/or freeze solid in the winter, the gastropods burrow into the mud to survive. A high amount of clay provides the most effective protection. The lack of clay at the Melhagen site certainly affected the survival of the gastropods.

Ostracods were also recovered in the flotation study. These small "seed shrimp" are usually between 1 mm and 3 mm in size. They are opaque and have a bivalve shell. They inhabit "standing and running waters, including rooted vegetation, algal mats, debris, mud, sand and rubble" (Pennak 1989: 443). Their food consists of bacteria, molds, algae and fine detritus, "but some of the larger Cypridae have been observed feeding on living and dead animals. Ecologically, ostracods are omnivorous scavengers" (Pennak 1989: 444). Their egg development is suspended in dry and cold periods, although eggs have been viable in dried pond mud for up to 20 years. They have a lifespan lasting from several weeks to eight months. Most species live in water that is less than one metre deep, although some have been found up to 15 metres deep. They tolerate a wide range of ecological factors (Pennak 1989: 448).

Since so many snails and ostracods were recovered in the Melhagen soil samples, and were also recovered primarily from the bone bed, it is clear that the site was covered by a slough at some point in time. It is highly unlikely that all of these shells would have blown in from some unknown source, since they are distributed well throughout the site. The slough was alkaline, and probably was not very deep. If present-day sloughs can be used as comparison, then it is possible that the depth of this slough fluctuated considerably within any given year, as well as over a period of years.

Bone

All samples contained varying amounts of uncharred bone with a large proportion that had been affected by mineralization. The bone was small, fragmented, and generally unidentifiable. Burned and calcined bone represented 21% of the total bone and occurred in all samples but two control samples (Deck 1988: 12).

Artifacts

Artifacts included lithic shatter, flakes, and microflakes. Some of the raw material is Swan River chert and Knife River flint. Lithic fragments totalled 13.55 grams from seven of the samples (Deck 1988: 12).

Comparison of Cultural and Control Samples

There was a difference of only one litre for the total volume of the cultural vs. the control samples (Table 7.3). The control samples contained more uncharred seeds (77%) and less charred seeds (40%) than the cultural samples. Only a trace of lithic fragments from one control and a small amount of charcoal and burned or calcined bone was found in the controls. Insect remains, however, were more abundant (61%). The cultural samples contained the bulk of the faunal remains and shell.

Ostracods and what appears to be snail eggs were only found in the cultural level (Deck 1988: 12).

d) Flotation Analysis Summary

The remains recovered in the flotation study support the hypothesis that the site was located in some sort of a wetland (Deck 1988: 14). This was indicated by the presence of Gastropod shells, Ostracods, mineralized bones and by the lack of charred seeds.

Preservation of ancient floral remains was generally poor. This may be related to the conditions at the time of occupation, which were generally wet. It may also be related to the age of the site, or sampling procedures may have missed features containing charred remains.

Uncharred seeds in the cultural level may have been deposited by vertical seed dispersal through root holes, cracks in the soil, downwashing, insects and burrowing animals (Minnis 1981). It is interesting that most of the uncharred seeds recovered in the flotation study are introduced species from Europe, and are common in disturbed soils and in overgrazed pastures. This indicates a high rate of contamination, which may have occurred during the flotation processing, or if the deposits had been exposed on site before the sample was collected. Quite often contamination is a factor of the soil's natural seed bank (Keepax 1977; Minnis 1981).

2.3.4) Paleotopography

a) Introduction to the Paleotopography Study

The reconstruction of past landforms can require a broad range of studies including the anlaysis of maps, air photos, remote sensing, and sediment composition and texture studies. The soils in and around the Melhagen site have already been examined, and a contour map of the present topography can be seen in Figure 1.4. An air photo demonstrates the presence of parabolic dunes in this area (Figure 1.3), as well as local vegetation patterns.

Dincauze (1987: 271) has noted that the paleotopography of the buried surfaces of archaeological sites is seldom given any attention, especially by North American archaeologists. This is because many tend to excavate in arbitrary levels rather than natural ones. According to Dincauze (1987: 271), North American archaeologists instead seem to prefer to conduct sedimentological and pedolgical analyses only as a way to augment stratigraphic interpretation.

b) Method of Paleotopography Reconstruction

The paleosol (bone bed layer, or Level 2) was surveyed using a theodolite mounted on a tripod and a stadia rod. A reading was taken at each test pit on the 10 metre grid (Figure 1.5). One reading was done at the ground surface to produce the contour map of the present elevation (Figure 1.4). Another reading was taken at the top of the paleosol in each test pit (where it was visible) to produce the paleotopography map in Figure 2.10. The thickness of the paleosol was also recorded.

One source of error on the map could have occurred in the areas excavated by Phenix. Much of the paleosol was removed during excavations here, so the actual elevation of the paleotopography and the present topography prior to the excavations was probably much more than what is seen in Figure 2.10.

c) Analysis and Discussion of the Paleotopography

Figure 2.10 demonstrates that there is a drop in the elevation of the paleosol of 0.75 metres from the west to the east of the site (Hall 1988: 35). This trend is consistent with, or similar to, the topography of the present elevation (Figure 1.4). The highest paleosol elevation (579.5 metres) occurs towards the western edge of the site. There is a gradual slope towards the east fence, where the eleveation is 578.75 metres above sea level. The highest present elevation is also at the west of the site, at 580.5 metres above sea level, and the lowest is at the eastern fence at 579.0 metres. The drop in the present elevation from west to east is therefore 1.5 metres (Hall 1988: 35).

The elevation of the base of the paleosol should also be examined. When the average thickness of the bone bed is subtracted from the height, the base elevation can be calculated. On the west side, the base elevation would average at about 579.1 metres above sea level, and the east side base elevation would average about 578.55 metres above sea level. (The bone bed is thicker on the west than on the east side). Thus the base elevation drops about 0.55 metres from west to east. This is not really a major drop, and there is no way to account for the amount of compression that may have occurred when the aeolian sand was deposited on the bone bed.

2.3.5) Summary of the Paleoenvironment

The Melhagen site is, and was located within a depression between dune ridges. It has been shown that conditions at the Melhagen site were much moister in the past than they are now. These conditions probably meant that the water table of the area was higher than it is now, and that the area was once covered by a slough. The level of this slough probably fluctuated over time and throughout the seasons. It is not unreasonable to expect that trees and shrubs proliferated here in the past, as similar stands are commonly found in low-lying wet areas of the sand hills. Snail shells, snail eggs, ostracods, evidence of trampling and loadcasting provide corroborative support to this hypothesis.

At some point, a high energy environment developed, perhaps as a result of a drought and/or some major destabilization of the dunes to the north and west. Perhaps the destabilization was precipitated by the bison drives themselves. Travellers in historic times noted how the bison caused widespread erosion in the sand hills (Spry 1968: 146). Portions of the slough and edges of the bone beds eroded, while the thicker, wet, highly organic bone beds attracted vegetation and sand particles. They were probably covered rapidly, preserving the hoof prints seen on the surface of the bone bed in some places, and probably produced some of the loadcasting structures we see today. The effects of these post-depositional events will be discussed in the next section.

2.4) Environmental and Other Factors Affecting the Analysis

2.4.1) Introduction

Much of the site analysis has been limited by a number of factors that are directly related to the environmental conditions of a sand hills environment. All of these factors have ultimately led to the fragmentation of the archaeofauna and hence, the reduction of the identifiable faunal sample size. These processes are encompassed in the field of taphonomic studies and are relevant to various analyses in this thesis.

Agents of the natural environment which modify animal carcasses can be separated into two major categories. The first group of natural agents which alter archaeofaunal assemblages are related to geophysical processes, and include such things as frost-heave, mass wasting, argilliturbation, and aeroturbation. The second of these concerns biological processes, including those agents responsible for the decomposition, the order of disarticulation, root etching, animal trampling, burrowing and gnawing. Archaeologists have been interested in these natural alteration processes for some time. It is extremely important to be able to distinguish them from culturally-induced processes resulting from such activities as butchering and food processing.

This discussion will outline the effects of natural agents which have affected the Melhagen site assemblage. Some of these processes affect lithic artifacts as well as faunal. Cultural modification of bone will be discussed in a later chapter.

2.4.2) Natural Alterations: Geophysical Processes

Wood and Johnson (1982: 557-593) have outlined in some detail several natural processes that affect bone assemblages. Processes that are of interest to this discussion include chemical weathering, frost-heave, loadcasting, and aeroturbation (soil gas and wind).

White and Hannus (1983: 321) have described the chemical weathering of bone "as overlapping reactions that are controlled by water, acid, oxygen, calcium contents in bone and soil." Behrensmeyer (1978: 154), described five stages of bone weathering. She found that the greatest amount of weathering occurs in the zone immediately above the soil. This means that one end of a bone could weather faster than another. For the most part, bones weathered less on the lower surface than on the upper. When the bones were deposited in highly alkaline soils, however, the lower surfaces weathered faster (Behrensmeyer 1978: 154). Direct sunlight also causes bone to weather faster than bones that are sheltered (Gifford 1982: 516).

At the Melhagen site, bone that was on the surface of the bone bed was always more weathered than the bone within it. This could be due to the chemical weathering described here, but is also due to wind erosion and exposure to the sun. Soils in the eastern side of the excavations appear to have a higher amount of alkalinity, and bones recovered here are much more fragmented than bones from other areas. This is related to the presence of the slough. Bones on the eastern side were probably under water more than bones on the west side.

Temperature is also an important taphonomic factor, since intense heat can cause significant changes in the colour, crystalline structure, size and microscopic morphology of bones and teeth. These changes are a function of the changes in hydroxyapatite and collagen (Shipman *et al* .1984: 322). Shipman was able to establish five stages of change in bone which correlate to temperature changes between 20° C and 940° C. This data cannot be used to distinguish between natural and man-made fires, because it takes up to two hours for the bone to heat up to the temperature of the heating agent. Grass fires are short, and their heat is not very intensive. Forest fires can last a long time and produce very intense heat, thereby causing changes in bone that would mimic man made fires. Cooking meat does not necessarily raise bone temperatures significantly, but tossing bones into a fire does (Shipman *et al* .1984: 323).

On the Plains, frost-heave plays an important taphonomic role and mixes objects in the soil. Experiments by Johnson and Hansen (1974: 90-96) have demonstrated that frost heave will occur if moisture is present in the soil, and if the freezing extends to the level of the objects. The amount of heave depends on several conditions including the frequency and rate of frost penetration, and the amount of moisture. The amount of ground cover is important as heavy vegetation cover results in less movement. The depth of the object's burial, its size, geometric shape, orientation, density and thermal properties all affect the amount of heave. Soil texture, porosity, permeability, density, salinity, minerology and organic matter affect the rate and degree of frost heave (Johnson and Hansen 1974: 90-96).

Frost-heave therefore affects the provenience of artifacts, but it also affects the bone itself. Freeze-thaw cycles are linked with wet-dry cycles too. Split-line cracks occur between collagen bundles along the longitudinal axis of long bones as a result of changes in the water content or state of water in the bone. Bone tends to lose water when it is frozen. When gypsum or montmorillonite enters into the bones, the expansion factor is increased with wet-dry and freeze-thaw cycles. Exfoliation also develops from this, and results in horizontal splitting of the lamellar surface layer of bone, causing it to peel like an onion (Bonnichsen and Will 1980: 9). Evidence of a similar process was especially prevalent in the Phenix collection, which had been stored outside for a number of years after excavation.

Less common in the literature are references dealing with the effects of sedimentary processes on bone. Abrasion on bone through bioturbation, loadcasting or aeolian processes (sandblasting for example) is not well known in the literature. Gifford (1982: 519) has noted that "abrasion as an indicator of the operation of preburial processes" has not been experimentally examined. Suggestions have been made that weathered bone resists damage through abrasive processes less than fresh bone, and that elements with more compact bone in the proportion to spongy bone are more resistant.

More important to this discussion is the effect of animal trampling and loadcasting on the bone matrix at the Melhagen site. The undulating surface of the bone bed indicates that it may have been trampled by ungulates in some places. Trampling may cause a muddy bone matrix to become fluid or plastic (Egginton 1979: 355). The undulating bone bed surface, however, was identified by Michael Wilson (personal communication 1987) as an example of the process of loadcasting. A characteristic feature of loadcasting is the development of "flame" structures along the surface of the bone layer. It has been described as a phenomenon:

> caused when saturated deposits are subjected to the addition of more sediment, with a consequent need for the redistribution of weight. More specifically, they result when heavier sediment overlies lighter sediment: when there is a reverse density and gradient. (Wilson 1983: 231).

Typically, "the protruding material is ... sand that has sunk down into ... soft mud" (Blatt et al 1980). Reineck and Singh (1980: 84-86) have described loadcasting among four other penecontemporaneous deformation structures including ball and pillow structures, convolute bedding, dish structures and slump structures. Ripple crests of overlying sand can sink down into the mud, pile up and rotate. Sometimes lateral movement of the loading may occur, resulting in the production of flute-like marks. Both of these structures were seen in the Melhagen site profiles (Figures 2.1 to 2.9).

There is no way of knowing whether animal trampling or loadcasting caused by aeolian deposition was the dominant cause of this disturbance. It is also difficult to assess the degree of its effect on the bone beds at the site. Undulating surfaces are much more clearly defined in some areas than in others. The primary result has probably been various degrees of mixing within the bone bed matrix, which have redistributed bones and artifacts.

Several episodes of erosion and deposition took place at the Melhagen site. Wind and chemical agents of weathering are the primary cause of patterns seen on bone elements which were lying on the surface of the bone bed. These bones often display an exfoliated and roughened surface. Bone fragments and tools are spread out beyond the margins of the black occupation layer, providing evidence of the erosion which has taken place especially at the margins of the bone bed concentrations (Hall 1988).

2.4.3) Natural Alterations: Biological Processes

There is a large body of literature in which the effects of biological agents affecting bone assemblages have been recorded by experiments and observations. Some of these are related to the decomposition processes of animal carcasses. Observations by Hill (1980: 147) indicate that the bones of smaller animals, and those older animals whose bones are softer, tend to decay and disappear from the fossil record much faster than larger animals. This is important to the Melhagen site analysis because foetuses, juveniles and very old bison are underrepresented in the faunal assemblage.

Roots are capable of causing a great deal of damage to bones. They will "seek out bone deposits [for phosphates] and will dissolve the bone through the action of acidic exudates" (Carbone and Keel 1985: 11). This effect has been noted also by Bonnichsen and Will (1980: 9), and it accounts for the dendritic pattern often found on bone surfaces. Root damage is prevalent at the Melhagen site. They have grown through the bone, causing it to shatter. This process destroyed so many mandibles that the seasonality study sample was severely reduced.

Bones lying on the surface of the ground are exposed to trampling effects, especially around watering areas where ungulates tend to congregate. This has been noted by Behrensmeyer (1978: 154) and Gifford (1982: 514). Haynes (1983: 111) has described how bison wallowing (which is especially frequent and violent during the rutting season) moves, buries, and exposes bones, resulting in splintering and crushing of ribs, vertebrae and scapulae. Mandibles are often broken, the teeth scattered, pelvises fragmented, and even slightly weathered bone may be partially fragmented. Trampling is especially important in the formation of spiral fractures in long bones. It had been previously thought that only humans can produce such fractures. It is evident now, that spiral fractures can be produced by trampling, especially when the bone is relatively fresh, or "green" (Haynes 1980). This phenomenon is especially important when it comes to distinguishing true bone tools from pseudotools in archaeological assemblages.

Ungulates also gnaw, and sometimes consume bone from time to time, especially when they inhabit areas that lack sufficient salts and minerals (Gifford 1978: 79; 1982: 514). Carnivores will often ingest bone while gnawing it. The result is a "characteristic polished and 'dissolved' appearance, often with sharply pointed ends" (Behrensmeyer 1978: 154). Rodents prefer to gnaw on bones that are free from fat and sinew (Gifford 1982: 514).

Carnivore gnawing has also affected the interpretations of the Melhagen site. A large amount of experimental work has been done in this area. Haynes (1980) studied patterns of gnaw damage caused by wolves on bone. He found that skulls and mandibles are often wholly consumed from the nose in. In well-utilized kills, the spinous processes of all the thoracic, all the lumbar and the last two cervical vertebrae are usually broken off in butchering. Since carnivores also chew these processes off of vertebrae, it may be difficult to distinguish carnivore and human activity. Long bones are usually gnawed from the proximal end (Haynes 1980: 345-348). Carnivores generally start chewing at the epiphyses, and do not crush the bone into small fragments. They can produce spiral fractures and flaking, but in these cases, chew marks are usually evident as well (Haynes 1983: 104). These patterns were very common at the Melhagen site. Carnivores are believed to have effectively reduced the faunal assemblage, as evidence of their activity was noted on a significant portion of the sample.

Binford (1981) has also examined gnaw damage. He recognized four types of tooth marking on bone, including punctures, pits, scores and furrows. All of these types of damage have been observed on the Melhagen site archaeofauna. Punctures result from direct pressure on the bone by teeth. Pitting occurs on bones that have been gnawed extensively, as the carnivore moves from the spongy bone to the more dense bone. Scoring results from the animal "either turning the bone against the teeth or dragging the teeth across relatively compact bone" (Binford 1981: 46). The resultant linear scarring may resemble cut marks from tools in that they often run parallel and are close together. Scoring marks differ in that they are shallow on flatter bone and deep on bone with a sharp curve.

Furrowing results in a hole, or "scooping out" effect when the carnivore removes cancellous bone. This is often associated with ridges on the remaining cancellous tissue (Binford 1981: 48).

Animal burrowing tends to affect bone provenience, as small mammals tend to dig through the bone layers and push obstacles around. Some gopher burrows were found at the Melhagen site, as well as some gopher bones.

2.4.4) Post-Excavation Factors Affecting the Analysis

A certain amount of data was lost during and after excavations despite the best efforts of the archaeologists. After Phenix completed his fieldwork, he stored the artifacts and bones in the basement of his home. Unfortunately, a freak storm one spring flooded his basement, and the boxes of bones were saturated. He removed them to a storage area in his back yard and covered them with a tarp. They stayed there for about three years until this author removed them to her lab. It was discovered that much of the faunal collection had badly deteriorated from the wet-dry and freeze-thaw exposure. Long bones were brittle and were flaking away. Smaller bones were literally crumbling to dust. Furthermore, provenience information had rotted away with the tags and labelled bags of bone. Only a few of the 23 boxes of bone in the Phenix collection had any provenience information at all.

Such problems are unavoidable when proper storage facilities are not available to researchers and collectors. In this situation, it was recognized that the need to complete the analysis of the Melhagen site was extremely urgent. Otherwise, it is likely that much of this information would never have reached this level of interpretation, and probably would have been lost by now.

This situation has resulted in a severe reduction of the faunal sample size. A few research interests have had to be omitted, and some interpretations unfortunately rely on incomplete or small samples. It is difficult to assess the degree to which natural, cultural and post-excavation factors have affected the Melhagen site analysis at this point. In the following chapters the implications of these processes will become more apparent.

CHAPTER 3

Ethnohistoric and Archaeological Background to Communal Bison Hunting and Utilization

3.1) Early Travellers in the Elbow Region

Early European travellers passed through the Elbow Region and many parts of western Canada in the mid to late 19th century. The observations and experiences that they recorded resulted in much of what we know of the aboriginal people, their Northern Plains habitat and their lifeways. This information may be used by archaeologists to help explain the archaeological record.

Some descriptions of the Elbow region by these early travellers are relatively sketchy (Cowie 1913: 388; Fidler 1967: 261, 266). Fidler apparently saw three earth lodges above the Elbow when he travelled through in September, 1800. This sort of housing was common among the Hidatsa people. If Hidatsa were in this area in historic times, it would indicate that some degree of movement and trade occurred in the past between the Middle Missouri and the Northern Plains regions.

The Elbow area was of particular note not only because of the bend of the South Saskatchewan River, but also because of the presence of Aiktow Creek ("the river-that-turns") and its alternating direction of flow. Palliser (Spry 1968: xcvi) and Southesk (1875: 75) both noted that the map that Fidler had made of this region was incorrect. He had placed the source of the Aiktow Creek about 97 kilometres to the east of the Elbow, when in fact the distance was actually 19 kilometres (Southesk 1875: 75). It was correctly mapped by Henry Youle Hind in 1857 (Hind 1971 *i* : 366). This map also depicts the location of a Cree bison pound and several Cree camp sites along the Aiktow Creek and the Qu'Appelle River Valley. The remains of camp sites in this general area were also noted by Southesk (1875: 77, 89). Many of these sites, and no doubt several others, were flooded with the construction of the Gardiner and Qu'Appelle dams in the 1960's.

References to the sand hills east of Elbow are found in the writings of the Earl of Southesk, who may have actually passed close to the Melhagen site area. His party travelled up the Qu'Appelle valley,

> ... till we came to the Sandy Hills, the first of which we ascended. These Hills, covering a considerable tract, are about 200 feet high, and are entirely composed of sand as fine as that of the sea-shores. Near them the grass grows short and scantily, much as on some of the "links" along the Scottish coast. The Crees fancy that the souls of good men enter into a paradise concealed amidst these arid ranges, while the souls of the bad have to pass over an exceedingly narrow bridge, whence they fall into pits of despair and utter wretchedness (Southesk 1875: 71).

One of the major difficulties of survival in the sand hills was the scarcity of drinking water, as many of the sloughs were so brackish that the horses refused to drink (Southesk 1875: 73-74). The desert-like conditions did not go unnoticed by Palliser, who thus described the area between Riverhurst and Elbow:

> ... country throughout was arid and sterile, still muddy swamps frequently occur, in which are to be found wild fowl in great abundance.... Buffalo were also here in great numbers, as well as their constant attenders the wolves, ever ready to attack a worn-out or wounded straggler, or some stray calf.... The grass in this arid soil, always so scanty, was now actually swept away by the buffalo, who,

> assisted by the locusts, had left the country as bare as if it had been overrun by fire... (Spry 1968: 145-146).

Historically, the region had served as a sort of territorial marker. Southesk noted that a band of Crees had driven a herd of bison "before them to the hills about thirty miles up this south branch of the Saskatchewan, the farthest point in the Blackfoot direction to which the other tribes can venture" (Southesk 1875: 77).

The unique geographical features of the Elbow region and its surrounding sand hills most likely meant that it was well-known and very significant to the Northern Plains people. The topography provided a natural refuge for a wide variety of game, including bison, antelope, deer, bears, and waterfowl. Water sources were close-by, despite the aridity, and ample fuel could be found in buffalo chips, aspen and willow groves.

3.2) Ethnohistoric References to Communal Hunting

The communal hunting of bison has a long history and tradition on the Northern Plains. European travellers witnessed or participated in these communal hunts, and they sometimes came across the remains of a major kill site. Their journals provide a great deal of insight into the behavioral aspects of the bison and the methods used to exploit them. The historic accounts of early visitors to the Plains sometimes referred to the communal hunts of Plains Indians. The communal hunting techniques which were most often documented include the jump and the pound methods. Other techniques mentioned in the literature include the surround and the chases carried out on foot or on horseback. In addition, small hunting parties and individuals hunted the bison by stalking or by driving them into natural traps. Sometimes different methods were combined for a hunt. Most of these techniques have been quite adequately examined by Verbicky-Todd (1984).

Verbicky-Todd (1984: 35-37) indicates that pounds were used mostly in the fall and winter. These pounds were referred to by a variety of names such as buffalo parks, pens, drives and corrals. The Blackfoot called them "*pis 'kuns,* " which translates into "deep blood kettles" (Grinnell [1893: 228] in Verbicky-Todd 1984: 34).

Pounds were built either at the base of a natural slope, on level ground or at the base of a relatively steep precipice. When the pound was built at the base of a slope, the entrance opened towards the top so that the bison could not actually see the trap until it was too late. Many of the accounts reviewed by Verbicky-Todd (1984: 38) noted that poles were placed crosswise on the slope leading to the pound entrance, and were covered with manure and water. When this froze, the entrance was very slippery. This prevented the bison from turning around and escaping out of the entrance.

When pounds were built on level ground, a ramp leading into the entrance was constructed out of logs or snow. This ramp sometimes reached the height of the corral walls, so that the drop into the pound was between three and eight feet.

The corrals were constructed out of locally available trees and brush. Trees were laid down on top of each other, and branches, brush and twigs were interwoven among them. Sometimes poles were sunk into the ground for added strength. It was more important, however, to give the corral the *appearance* of being strong and solid. This was accomplished by draping hides all around the corral walls so that it looked like a solid obstacle. The bison would run around within the enclosure, looking for some clear space through which they could escape. Sharpened stakes were sometimes braced at an angle jutting into the corral, so that any bison who attempted to push through the enclosure would be impaled (Verbicky-Todd 1984: 39-40).

Pounds were usually round in shape, although square and rectangular ones were documented too. Sometimes multiple corrals were used, with one opening leading into another corral. The area of pounds ranged from 0.2 hectares to 0.6 hectares, and the entrance was from three to six metres wide (Verbicky-Todd 1984: 41).

The fence flared out from the entrance of the corral for distances ranging between 30 metres to 2.4 kilometres. Diverging lines of stakes, piles of buffalo chips, earth, brush or snow mounds extended for some distance, forming a funnel or drive lane into the corral. These were intended to resemble people, and hunters jumped out from behind them to frighten the animals and keep them running in the desired direction (Verbicky-Todd 1984: 41-43).

Success of the hunt depended on several unpredictable factors. Since its outcome dictated the welfare of the people for months to come (usually the duration of the winter), it is not surprising that intensive religious rituals were a central feature of the hunt. Sacrifices and offerings were made several days prior to the hunt, either at an entrance to the pound or at a tall pole or tree in the center of the pound. In some groups such as the Assiniboin and the Cree, one person was in charge of the rituals, planning and operation of the pound. This person was referred to as the "Poundmaker," "Chief of the Park," "Master of the Park," or "Master of the Pound" (Verbicky-Todd 1984: 43). In some instances, the Poundmaker's tipi was placed near the entrance of the pound. Among the Blackfoot, rituals were performed by owners of beaver bundles or buffalo rocks, while the logistical matters were supervised by the band chief (Verbicky-Todd 1984: 44).

Prior to the hunt, scouts were sent out to locate the herd. These young men directed and manipulated the herd towards the pound with a variety of techniques. Usually they tried to attract the attention of the herd leader by arousing their curiosity in some way, usually by disguising themselves as injured calves. Although bison are known to have very poor eyesight, their sense of smell is very acute. Thus the hunters had to be careful not to let the herd catch their scent. This part of the hunt could take several days, and so required a detailed knowledge of bison behavior (Verbicky-Todd 1984: 46-48).

Once the bison had entered the drive lane, the people along the drive lane would wave blankets to frighten the herd along the lane. As they entered the pen, bison apparently circled around in an east to west direction, looking for escape. Rituals may have been performed prior to and after the slaughter. In historic times, guns were not often used, since the noise tended to panic the bison even more. Bows and arrows, lances, hatchets and knives were used to kill the animals (Verbicky-Todd 1984: 48-51).

The butchering generally commenced immediately, and portions of the kill were distributed throughout the camp. In some cases the ritualist and/or the buffalo drivers received choice portions such as the liver, kidneys, tripe and tongues (Verbicky-Todd 1984: 52).

Everyone usually took part in the butchering, since it was a long and arduous task. The liver, kidneys, brains and brisket were often eaten raw during the butchering. Although all of the bison in the pound were killed, some travellers noted that often only the cows were butchered, as the meat of the bulls was not considered to be desirable except in the early summer (Ewers 1958: 76). Most of the meat and hide processing was done by the women at the camp, which was usually nearby. (Verbicky-Todd 1984: 53).

The bison pound was only one communal hunting method used by Plains Indians. Another documented method that is relevant to this discussion is the surround technique. In historic times, it was done both on foot and on horseback, and was probably commonly used in pre-horse days. Generally, a group of people on foot circled around a herd and closed in on it. Care had to be taken so that the animals would not catch the scent of the hunters. The herd would circle and mill about looking for escape, but would be met by people who were waving robes and shouting. The hunters advanced and shot the animals with great efficiency. Such a method of hunting was more flexible than the pound method because it did not require the construction of corrals or drive lanes, and bison did not have to be driven over several miles (Verbicky-Todd 1984: 133-140). Surrounds seem to have been practiced by Plains tribes in the summer, and in historic times became the preferred method of Southern Plains tribes (Verbicky-Todd 1984: 134).

The surround method required the cooperation of between 80 and several hundred people. This took a great deal of coordination, so very strict rules were followed. No one was allowed to hunt earlier than the appointed time, as this could startle the herd away from the area. Any person who disobeyed the rules of the hunt was punished. The severity of the punishment varied between groups, and depended on how plentiful the bison were. When the herds were small and scattered, individuals and small groups could hunt quite freely. However, when the herds were plentiful, practices were more restricted. "Without such restrictions, the Indians could easily be faced with ... starving in the midst of plenty" (Verbicky-Todd 1984: 32).

Stalking bison could be done in fairly small groups. Hunters crawled within firing range on their bellies, or they often made use of decoys and disguises. Sometimes the hunters disguised themselves as calves or buffalo wolves to get close to the herd, and on occasion were seen to stage a "wolf" attack on the "calf" to attract the herd. Several animals could be taken with this method before the herd realized the danger and moved away (Verbicky-Todd 1984: 159-163).

Natural traps were also used whenever possible. In historic times, the snow in winter was so deep that hunting had to be done on foot. This was not a difficult task, as the bison could be quickly bogged down in snow drifts. They made easy targets for the Indians who could safely walk up to them on their snowshoes. Bison were also chased onto ice where they either lost their footing, or else fell through and drowned. The Cree apparently

> ...would make a semi-surround and force the bison down the point on to the ice were they would fall and break their legs or hips, and were so generally helpless and slipped about so that they were readily slaughtered. This was called a "wolf pound," and was so called because the Indians say they first learned to do this by watching the wolves, who made a ready prey of the bison when they got them on the ice (Skinner 1914: 525).

No matter what technique the Plains Indians used to hunt buffalo, it is clear that they had to possess a detailed and intricate knowledge of bison behavior and their habitat. The historic documentation indicates that this was indeed the case. Furthermore, the historic records provide a valuable insight into bison behavior and human ingenuity, and assist in the reconstruction of activities at archaeological sites.

3.3) Bison Impounding Witnessed in the Elbow Region

It is fortunate that at least one major bison impounding event was witnessed only a few miles away from the Melhagen site, and this event may share several features analogous to the Melhagen Besant kill. The account was written by Henry Youle Hind as he passed through the region on July 25, 1857. The Cree were constructing a new pound at this time, as the one they had been using was full of rotting buffalo carcasses. Because this passage is so informative (although somewhat dramatic), it will be quoted in its entirety from Hind (1971 [1860] Vol. 1: 356-359).

> We passed through the camp to a place which the chief's son pointed out, and there erected our tents. The women were still employed in moving the camp, being assisted in the operation by large numbers of dogs, each dog having two poles harnessed to him, on which his little load of meat, pemmican, or camp furniture was laid. After

another smoke, the chief's son asked me, through the interpreter, if I would like to see the old buffalo pound, in which they had been entrapping buffalo during the past week. With a ready compliance I accompanied the guide to a little valley between sand hills, through a lane of branches of trees, which are called "dead men" to the gate or trap of the pound. A sight most horrible and disgusting broke upon us as we ascended a sand dune overhanging the little dell in which the pound was built. Within a circular fence 120 feet broad, constructed of the trunks of trees, laced with withes together, and braced by outside supports, lay tossed in every conceivable position over two hundred dead buffalo. From old bulls to calves of three months old, animals of every age were huddled together in all the forced attitudes of violent death. Some lay on their backs, with eyes starting from their heads, and tongue thrust out through clotted gore. Others were impaled on the horns of the old and strong bulls. Others again, which had been tossed, were lying with broken backs two and three deep. One little calf hung suspended on the horns of a bull which had impaled it in the wild race round and round the pound.

The Indians looked upon the dreadful and sickening scene with evident delight, and told how such and such a bull or cow had exhibited feats of wonderful strength in the death-struggle. The flesh of many of the cows had been taken from them, and was drying in the sun on stages near the tents. It is needless to say that the odour was overpowering, and millions of large blue flesh flies, humming and buzzing over the putrefying bodies was not the least disgusting part of the spectacle. At my request the chief's son jumped into the pound, and with a small axe knocked off half a dozen pair of horns, which I wished to preserve in memory of this terrible slaughter. "Tomorrow," said my companion, "you shall see us bring in the buffalo to the new pound."

After the first "run," ten days before our arrival, the Indians had driven about 200 buffalo into the enclosure, and were still urging on the remainder of the herd, when one wary old bull, espying a narrow crevice which had not been closed by the robes of those on the outside, whose duty it was to conceal every orifice, made a dash and broke the fence, the whole body then ran helter skelter through the gap, and dispersing among the sand dunes escaped, with the exception of eight who were speared or shot with arrows as they passed in their mad career. In all, 240 animals had been killed in the pound, and it was its offensive condition which led the reckless and wasteful savages to construct a new one. This was formed in a pretty dell between sand hills, about half a mile from the first, and leading from it in two diverging rows, the bushes they designate "dead men," and which serve to guide the buffalo when at full speed, were arranged. The "dead men" extended a distance of four miles into the prairie, west of and beyond the Sand Hills. They were placed about 50 feet apart, and between the extremity of the rows might be a distance of from one and a half to two miles.

When the skilled hunters are about to bring in a herd of buffalo from the prairie, they direct the course of the gallop of the alarmed animals by confederates stationed in hollows or small depressions, who, when the buffalo appear inclined to take a direction leading from the space marked out by the "dead men," show themselves for a moment and wave their robes, immediately hiding again. This serves to turn the buffalo slightly in another direction, and when the animals, having arrived between the rows of "dead men," endeavour to pass through them, Indians here and there stationed behind a "dead man," go through the same operation, and thus keep the animals within the narrowing limits of the converging lines. At the entrance to the pound there is a strong trunk of a tree placed about one foot from the ground, and on the inner side an excavation is made sufficiently deep to prevent the buffalo from leaping back when once in the pound. As soon as the animals have taken the fatal spring they begin to gallop round and round the ring fence looking for a chance of escape, but with the utmost silence women and children on the outside hold their robes before every orifice until the whole herd is brought in; they then climb to the top of the fence, and, with the hunters who have followed closely in the rear of the buffalo, spear or shoot with bows and arrows or fire-arms at the bewildered animals, rapidly becoming frantic with rage and terror, within the narrow limits of the

> pound. A dreadful scene of confusion and slaughter then begins, the oldest and strongest animals crush and toss the weaker; the shouts and screams of the excited Indians rise above the roaring of the bulls, the bellowing of the cows, and the piteous moaning of the calves.

Some features of this pounding event are worth pointing out. Apart from Hind's descriptions of the construction of the pound, its situation in the sand hills and the methods employed to bring in the herd, it is interesting to note that not all attempts were successful. Also, once the herd was brought in, the women and children participated in killing the animals. An impounding event no doubt gave the women and children a rare opportunity to partake in the excitement of the kill.

3.4) The Archaeology of Communal Hunts in the Late Prehistoric Period

Patterns observed in historic times are often reflected in the archaeological record. It seems that communal bison hunts have been an integral aspect of the Plains Indian lifeways for centuries. No doubt many of the oldest kill sites have been lost through time and erosion, so they are somewhat underrepresented in the archaeological record. Late Prehistoric kills are fairly well represented, especially multi-component jump sites. Jump sites are more visible in the archaeological record than pound or surround sites because they are located at the bases of terraces or steep slopes. Besant components are often recognized in jump sites across the Northern Plains. Because the Melhagen site is a pound or surround kill, these jump sites will not be discussed unless they relate to some specific aspect of the analysis.

Many of the pound or surround type sites are located in terrain that has few remarkable features, so are usually found through accidental exposure caused by erosion, or as a result of road or pipeline construction. Sandy soils can be especially unstable, so most of the sites discussed below are located in sandy areas.

Only three Besant pound sites other than the Melhagen site have been relatively well documented on the Northern Plains. These are spread over a large area. The Muhlbach site (FbPf-100) (Gruhn 1971: 128-156) (Figure 1.1) is located near Stettler, Alberta. The terrain consists of low sandy dunes that are covered by grass. The water table in this area was only three metres below the surface at the time of excavation. At the time of occupation, the climate was wetter, and a nearby pond could have actually extended over the site. Radiocarbon dates on charred bone yielded a date of 1270 $\pm$ 150 B.P. (Dyck 1983: 120).

The bone bed itself lies between two aeolian sand deposits, and was between 40 cm and 70 cm thick. The bone preservation was not very good. Gruhn (1971: 138) estimated that a minimum of 100 bison had been killed here, and that the actual number killed could reach 300. Concentrations of charred bone fragments seemed to indicate that intensive processing of bone had taken place at the kill site. No seasonality data was available when this report was published.

Several pits filled with upright bones were found, but these bones were too tightly wedged together to accomodate posts. Gruhn (1971: 139) suggested that these had perhaps been used as anvils in bone processing or stone tool manufacturing.

Over 60 projectile points were recovered here, and over 80% of these were made from Knife River flint. These projectile points are clearly similar to those recovered from other known Besant sites, and exhibit a wide range in size and shape.

No evidence of a corral structure, such as post holes, was found. Lack of postholes does not preclude the possiblility that a corral was used, as these could have eroded away or been missed in the excavations. The animals could have also been mired down in the marshy soil.

Gruhn's (1971) preliminary report does not include complete analyses of the material. Thus no further information about the site is available, except where others such as Reeves (1983a; 1983b) have analyzed particular aspects of the site in conjunction with their own research.

The Richards Kill site (Hlady 1967: 3-10) (Figure 1.1) in southern Manitoba is even more poorly known than the Muhlbach site. This site is located about two miles northwest of the town of Killarney in a glacial kettle depression. Like the landowners of the Muhlbach site, the people who owned this land discovered the site accidently in the early 1960's, and conducted some of their own excavations and collections. A radiocarbon date of 1240 $\pm$ 130 B.P. (Dyck 1983: 120) would indicate that this site is contemporaneous with the Muhlbach site.

Whitish yellow clay covered the bone bed, which consisted of a grey-black soil. The underlying soil was also clayey. Most of Hlady's (1967) discussion concentrates on the projectile points, which conform to the Besant typology. This collection demonstrates a wide variety in size and shape. The vast majority of the points were made from Knife River flint.

Unfortunately, no faunal analysis has been published on the Richards site materials. Hlady (1967: 8) did mention that wet-dry cycles had adversely affected the bone preservation. He did not say if any post hole or bone upright features were found here, so one must assume that these features were either absent, or had been destroyed by the landowners.

The Ruby site (Frison 1971: 77-95) (Figure 1.1) is one of the better-known Besant bison kill sites in the Northern Plains. It is located in the Powder River Basin in Wyoming, and is unique because a ceremonial structure is associated with it. The site dates to A.D. 280, or 1670 $\pm$ 135 years B.P., so it is possibly older than the Muhlbach and Richards Kill sites. The pound was located in an arroyo, the bank of which may have formed part of the retaining structure. Post holes were numerous at the site, and outlined the structure and a fenced drive lane leading into it.

The ceremonial structure was located 6.1 metres east of the pound and was also outlined by post holes. It was about 11.9 metres long and 4.6 metres wide, and shaped much like a football. Several skulls were arranged around the south end of the structure, and two pits outside contained articulated vertebral bones. Wood logs were preserved at the site, but do not display tool marks on the ends. The complete lack of tools typically associated with habitation structures supports the claim that this was a ceremonial structure.

The projectile points found here appear to be of both Pelican Lake and Besant affiliations. Frison did not wish to deal with the apparent cultural implications of this mixing of point types, but rather focussed on the functional implications of hafting areas and point size. He did recognize that the site was used over a period of several years, so this could account for the different point styles. Other lithic, antler and bone tools were also recovered, which reflect processing activities, as well as tool manufacture and resharpening.

The tradition of impounding bison continued in the Northern Plains through to historic times. Frison (1971: 90) suggested that in the Late Prehistoric period, "there was a trend away from pounds and an emphasis on jumping. More communal operations occurred in the latter period, but they do not appear more complex than the earlier ones."

After this article was published, several pound sites dating to the Late Prehistoric have been investigated and published. Many of these were found in Saskatchewan, including the Rousell site (Figure 1.1), which is located in the Dunfermline sand hills northwest of Saskatoon (Dyck 1972). This site is considered to be an Avonlea kill and butchering site, and produced a good quantity of bison bone and four Avonlea points.

The Tschetter site (Figure 1.1) is also located in the Dunfermline sand hills, and is a Prairie Side-notched pound kill. It was tested in 1971 by Ian Dyck (Dyck 1972) and subsequently excavated by Prentice (1983) and Linnamae (1988).

Since the topography and situation of the Tschetter site are comparable to that of the Melhagen site, some discussion is of merit at this point. The bone bed was also located within low rolling sand hills, and reached a maximum thickness of 35 cm.

Eight post holes were found, but did not define any sort of shape or dimensions of walls. Some did contain bone, which was probably used as a bracing support for the posts. Several concentrations of charcoal and ash were indicative of bone grease rendering or roasting pits. One other pit contained five thoracic vertebrae spinous processes stuck in an upright position. Evidence of storage pits were also found.

The faunal evidence indicated that the kill had taken place in the winter, and that the herd consisted primarily of females. Most likely this occurred in a series of events where small herds were driven into the corral. A MNI (minimum number of individual bison killed) estimate of 93 animals probably represents only a small portion of the actual amount of bison killed here, as much of the site had been destroyed with the construction of a road and buildings (Linnamae 1988: 91-115).

Other Saskatchewan Late Prehistoric pound sites (Figure 1.1) include the Gull Lake site (Kehoe 1973), the Bakken-Wright site (Adams 1975) and the Estuary Bison Pound (Adams 1977). The last of these did show some evidence of drive lanes.

Although jumps were well-used in the Late Prehistoric period, it is probably premature to state that they actually became the dominant hunting technique during this time. Jump sites are often found along river valleys subject to high intensity erosion. This process tends to make jump sites highly visible. Drive lanes on uncultivated river uplands can also be quite noticeable. There is also a good chance that many of the oldest jump sites have been swept away in floods, making older sites less visible than Late Prehistoric sites. Furthermore, archaeological impact assessments and mitigation studies have been concentrated on the river valleys in recent years because of dam and irrigation projects.

On the other hand, pound sites are generally found in marginal areas in fairly undistinguished terrain. They seem to often be found by accident or after some erosional event. In other words, they are much less visible than jump sites. This could lead to the impression that their use dropped off throughout the Late Prehistoric. The historical records, however, demonstrate that both pounds and jumps were still commonly used at the time of contact with White traders.

3.5) Introduction to Animal Carcass Processing and Utilization

Two primary goals guide the decisions that hunter-gatherers make in regard to resource use. These have been identified as:

> 1. The attainment of a secure level of food and manufacturing needs.
> 2. The maintenance of energy expenditure within a predefined range, determined partly by the need for population aggregation (Jochim 1976: 19).

Secondary goals also play a role in decision-making. These may generally be classified more as "desires," and would include the desire for good tasting foods, variety, prestige and the desire to maintain the differentiation of sex roles (Jochim 1976: 22). Any or all of these secondary goals may be sacrificed in the interest of primary goals.

One particular goal of hunter-gatherers which has received a lot of attention in the literature is the need to acquire a large amount of dietary fat, which is absolutely crucial for good health. The archaeological implications of this have been discussed by Binford (1978), Brink and Dawe (1989), Speth (1983) and others. All have examined how hunter-gatherer preferences and goals relate to the utilization of meat and fat-bearing elements, and how these affect what we see in the archaeological record.

3.6) Historical and Ethnographic Evidence of Bison Processing and Utilization

A thorough review of historical documentation of bison processing on the Plains has been provided by Verbicky-Todd (1984: 168-172) and Wheat (1972: 85-125). Frison (1978b: 301-328) discussed bison processing in light of ethnohistoric evidence and with reference to his own butchering experiments with stone and bone tools.

Depending on the tribe and circumstances of the hunt, butchering was carried out by the men, women and/or the children. Ewers (1955: 160) reported that it took a man and woman only one hour to butcher a bison. Any of several different methods were used, depending on how many animals had been killed, the distance of the camp from the kill, the number of pack animals, and how hides were intended to be used (Verbicky-Todd 1984: 169).

Carcasses were first slit down the back, side or belly, depending on the goals and intentions of the hunters. Wissler (1910: 41-42) distinguished between "heavy butchering" and "light butchering" techniques employed by the Blackfoot. If the carcass was close to camp:

> ... the skin was cut down the median line of the breast and worked loose. Then the carcass as it lay on the outstretched skin was disemboweled.... The fore quarters were removed by cutting down through the shoulder joints. Then cuts were made at the shins. The hind legs were cut off and the quarters cut at the hip joints. The back-fat was removed in broad bands. The breast and belly were cut away in one piece; then the short ribs, eight on a side, in two pieces; also two similar pieces of neck ribs. The parts of the loin containing the kidneys were taken next. The "boss ribs" (hump) were stripped. If there was a foetus it was tied up with the "boss ribs." The back bone was cut into two pieces. A chunk of meat from the rump and one from the neck were taken. The heart, tongue, brain, paunch and small intestines were taken. Sometimes the hoofs and some of the head meat were also taken. The marrow from the leg bones was usually eaten raw during the butchering. While, at the present time cattle are butchered in this way, the scarcity of food compels the Indian to use every part of the carcass.

"Light butchering" was employed if meat was fairly plentiful (Ewers 1955: 160), or if the kill was some distance from the camp. Wissler (1910: 42) described it as follows:

> In this case, the loins were cut out of the quarters. Then these were tied in pairs as before. The back-fat was removed in two pieces, and tied so as to lay across the horse. The loins with the kidneys, the meat from the boss ribs, the heart, the tongue, breast and groin were taken as before. The flesh over the ribs was worked off in one piece. The paunch was emptied and the small intestines stripped. The whole was then packed in the skin on a horse as for the "heavy butchering." Thus, the bones were left behind.

Mandelbaum (1919: 58) described butchering done by the Plains Cree:

> In butchering, the carcass was turned on its back and the head jerked to one side to prop it up. The hide was removed along one side then the head was tilted again and the skinning proceeded on the other side. The flayed hide was spread on the ground the meat heaped on it. The long sinews from the backbone and the shoulder were carefully extracted. The limbs were dislocated and cut off. A cut was made along the backbone and the ribs chopped off.

Some parts of the bison such as the liver, kidneys, bone marrow, brains and brisket were consumed raw during the butchering. All animals in the pound were killed, but it was reported that in the fall, only the cows were butchered (Ewers 1958: 76) and bulls were left for the dogs. This is related to the fact that cows have a high nutritional value (fat content) in the fall while bulls are fat-depleted. In the late spring, bulls are in better condition than the cows and thus may have been preferred while the cows were virtually ignored (Speth 1983: 103-106).

Historical and ethnographic accounts note that after the animals were butchered, parcels of meat were taken back to the camp for further processing and distribution. Ewers (1955: 168-170) reported that only choice parts were eaten when meat was plentiful, but in times of food shortages every nourishment-yielding part of the bison was used.

Meat was boiled, roasted or dried. Soups were favorite meals, and pemmican could be stored for years if properly made. Pemmican was made from pulverized dried lean meat, and was sometimes mixed with ground berries. It was coated with fat and stored in a rawhide container for up to thirty years (Verbicky-Todd 1984: 182). The nourishment contained in one pound of pemmican could equal up to five pounds of fresh meat (McHugh 1972: 89; Wissler 1910: 23).

3.7) Archaeological Patterns of Bison Processing and Utilization

These butchering practices were generally similar in most ethnographic and historical descriptions and seem to change little over space and time (Falk 1977: 155-156; Gilbert 1969: 293). Archaeological communal kill sites therefore often display common features related to these practices, with some minor variations. These have been described in great detail by several researchers (see Clark and Wilson 1981: 37-50; Frison 1968: 33; 1971: 262-266; 1973: 34-50; 1974: 35-51; Frison, Wilson and Walker 1978: 11; Frison, Wilson and Wilson 1976: 50-52; Johnson 1980: 83-84; Johnson and Holliday 1981: 183; Kehoe and Kehoe 1960: 422-423; and Reeves 1983b: 39, 46-49 for a few examples). For instance, when tongues were removed from the mandibles, the articular condyles were commonly broken. Thoracic spines were often broken when the brisket was removed, and articulated vertebral segments are commonly found with their proximal rib ends. Pelvic units were often broken either at the pubic symphysis or at the acetabulum to remove the meat from the hind quarters. Skulls were often smashed to obtain brains, and long bones broken to extract marrow. Most of these features are reflected at the Melhagen site, and will be examined more thoroughly in Chapter 7.

CHAPTER 4

Previous and Current Research at the Melhagen Site

4.1) Previous Research: The 1967-1972 Phenix Excavations

4.1.1) Research Goals

After the site was discovered and reported by a group of hunters, testing was conducted by Greene, Houghton and Penner in an area south of the most eroded bone bed (Area D). The information in the Phenix files indicates that they tested 18 units of three-foot squares (Figure 1.5). They found six identifiable projectile points, one unidentifiable point, one endscraper and one broken knife within an extensive layer of bone. In addition to this, they found the only fragment of pottery recovered to date on the site, but unfortunately little is known of its original provenience. One notation states that it was found above the bone layer, and so may be intrusive.

With the realization that the site was significant, it was reported to the President of the Saskatoon Archaeological Society, Tom Phenix. It was then decided that excavations should proceed. This was especially important because the site was in danger of being lost through erosion caused by cattle and disturbance by pothunters. By the spring of 1968, cattle had already knocked over the original survey stakes, and some artifact-seekers had dug through a portion of the northern block of Area D (called "Mound 2" in Phenix's files).

The director of the PFRA, M.J. Fitzgerald, granted permission for the excavations and generously supplied fencing materials so that the site and cattle could be protected from each other. Excavations were undertaken by the Saskatoon Archaeological Society under the direction of Phenix in May, 1968 (Phenix 1969: 13).

4.1.2) Research Methodology

The site was fenced off to the west of the dugout, from the northeast corner marker of N E 22-24-3W3. A 50-foot base grid was surveyed in from a somewhat central datum stake labelled "0 west, 0 south." A nail was driven into the southwest post of the PFRA dugout fence at ground level, and was given an arbitrary elevation reference datum of 100 feet above sea level. This post is actually the southeast corner of the fenced site area. Although most of the site is contained within the fenced-off area, there is a mention in Phenix's notes that they went through a layer of bone while installing a post in the west fence.

A five-foot square excavation unit was used as the standard grid size. Each was labelled in its northeast corner. These were subdivided into 25 one-foot squares. Each one-foot square was given a "grid" number with the system utilized in labelling sections of land. That is, the southeast one-foot square "grid" was designated as "Grid 1", and the squares were numbered sequentially to the west, and snaked east and west towards the north of the unit. Thus, Grid 12 in Unit 100W 60S was actually located at 101W 62S.

Artifacts in the Phenix collection were numbered with an alphabetical abbreviation system. Capital letters were placed at five-foot intervals along the line running west from the central datum, and small letters were placed along the line running south from the central datum. Therefore, an artifact found in Grid 20, Unit 100W 60S, was encoded as EgNn1-Wm-20. This system worked well for the units which were south and west of the central datum, but became unworkable for those that were in any other quadrant of the site.

Volunteers came out to the site on weekends and holidays for the rest of the summer, and assisted in the years to follow. Phenix reported that few visitors dropped by because the site was relatively inaccessible (Phenix 1969: 13). Field drawings and notes were generally very well kept by the volunteers and by Phenix. Units were excavated with shovels and trowels, and the dirt was sifted through a relatively fine screen: most likely a standard window screen. This is probable because of the large number of microflakes recovered.

The excavation planviews were carefully redrawn by D. Robinson on a standardized form. These have proven to be especially valuable for this present study since much of the faunal provenience, and some of the lithic provenience has been lost. The bones and artifacts were removed from the site and stored in Phenix's basement until the spring flood mentioned in Chapter 2 forced their removal to a storage area in his back yard.

Phenix continued to work on the analysis of the Melhagen materials for several years. He attempted to establish a count of the minimum number of individual bison killed at the site from the mandibular third molars. He published a short report on the first season of excavations in the SAS *Newsletter* (Phenix 1969) and displayed his findings to the public on several occassions. Because of personal time constraints, however, he was unable to publish any sort of in-depth report or analysis, despite his desire to do so.

The Phenix faunal collection and some of the lithic artifacts were never properly catalogued until now. Due to the condition of the faunal materials it was necessary to complete an inventory and analysis of the collection. All the materials were washed, sorted and catalogued by the author in a laboratory at the University of Saskatchewan. Provenience information was recorded when it was available. The records were stored on IBM DBASE III and DBASE III+ files. Copies (on disk and paper) of the complete inventory will be kept by the author, Tom Phenix, the University of Saskatchewan Department of Anthropology and Archaeology, and the Heritage Resources - Archaeology Heritage Branch in the Saskatchewan Family Foundation Department, in Regina.

4.1.3) Summary of Results

The only published report of the Melhagen site was written after the first field season (Phenix 1969:13-15). The report indicates that excavations went into the middle of October 1968, and were concentrated on one of the five bone beds. Seventeen units of five-foot squares were completed. The stratigraphy showed that a foot of sand had been deposited over the bone bed, which was level at the time of the kill. This formed a hillock or "mound" over the bed. The bone layer was from four inches thick throughout most of the mound, to one inch thick at the edges. Bone was very compact, and thoroughly mixed with little or no articulation. Small snail shells appeared in the screens during the excavation. Several flakes, 35 identifiable projectile points, 19 unidentifiable points, and two each of endscrapers, complete knives, broken knives and flake scrapers were reported to have been recovered.

Phenix (1969: 14) noted that:

> Many of the points appear to have been reworked, several may have been used as knives. One point, the only patinated one, is chalcedony and has flakes removed from both sides, which indicates that it is a reworked older point. One chert point seems to have been renotched to be used as a knife.... The points from the east end of the mound are mostly short, whereas the longer ones are from the west end. The chert and quartzite points were mostly from the south side of the mound.

Since no reports were published for the subsequent years of excavation, any discussion of the total area excavated by Phenix must be based on his files and notes, and so is at best an estimation. It must also be kept in mind that some areas were pothunted by unknown persons. The map in Figure 1.5 outlines the approximate locations of both Phenix's and the undocumented excavations. In total, Phenix excavated between 52 and 67 five-foot square units (24 to 31 square metres). Because some of the provenience information is missing, it is difficult to establish a more exact estimation than this.

4.2) Current Research: The 1986 Excavations

4.2.1) Research Goals of 1986

The evidence in the archaeological record indicates that the Besant people excelled in the communal bison hunt. The ethnographic record demonstrates that intense ritualism was integral to the hunt in order to ensure its success. Archaeological evidence from the Ruby site (Frison 1971) shows that religion had played a large role in the communal hunt for some time. It is still not known, however, if the Ruby site represents a "typical" Besant communal hunt, or if it is unique. It was one of the original objectives of this research to see if bison hunt ritualism could be found at this site, and to try to relate this to the presence or absence of either environmental or cultural pressures.

The high proportion of Knife River flint in the Phenix collection is a characteristic that others (Gruhn 1971; Hlady 1967; Reeves 1983a) have said is common to Besant sites. Since this material is imported from the North Dakota region, it was hoped that further excavations might indicate trade patterns. Excavations were also needed to test and augment the information provided by Phenix's notes and records. Little work had been done on the stratigraphy and activity areas across the site. One of the most important goals, however, was to make this information available to the general population, and to involve the public in the research. Since much of the funding came from public sources, this was seen as an opportunity to educate people about archaeology, and thereby raise the profile of archaeology in the community. In short then, the main goals of the 1986 field season were:

(1) To preserve the data which had been gathered so far from the site,
(2) To augment this with new information gathered in a scientific manner,
(3) To provide the public with an opportunity to learn about the goals and methodology of archaeology,
(4) To test the site for evidence of ceremonial, technological and subsistence-related adaptations to environmental stress, especially in the context of communal bison procurement,
(5) To examine possible lithic procurement by trade and,

(6) To test the site for activity areas, especially for areas of grease extraction from bone marrow, tool resharpening and manufacture, and butchering patterns.

4.2.2) Research Methodology of 1986

a) Field Methodology

In early May 1986, a ten-metre grid was established from the old central datum point. The datum was relabelled 100 South, 100 East (100S 100E). The grid was aligned to magnetic north, with an angle of declination of 15° from true north. All pits were designated from their south east corner.

In June we dug 50-centimetre test pits at each 10-metre grid pin to determine the horizontal and vertical extent of the bone beds. The dirt from each test pit was sifted in a 0.64 cm screen, and artifacts were retained for further analysis. The depth of the top and bottom of the cultural level were measured in from the ground surface level of the south east pin. The depth of each test pit was also recorded. Four test pits were also dug in in the dugout area east of the site fencing to test the extent of the bone bed in that direction. Unlike the others, which were in the fenced off area, these units were filled in as soon as the measurements were taken. Although the dugout was also fenced off, this precaution was taken in case the PFRA decided to use the dugout again for watering the cattle.

Since Phenix had excavated largely towards the western side of the site, it was decided to concentrate our excavations in other areas. A two-by-one metre test unit was therefore placed beside the eastern fence (Area A). With these two units, the following excavation method was devised. Each one metre unit was excavated in 50-centimetre quadrants. The covering aeolian sand layer (Level 1) was shovelled out and the sand was sifted through 1/4 inch screens. One quadrant was selected at random to be sifted through a fine window-screen continuously throughout the unit. This was done in order to test for the presence of microflakes, small artifacts and faunal remains which would otherwise be lost in the backfill. These items would indicate the presence of tool resharpening and manufacturing. This became difficult after (and during) heavy rains, when the soil completely plugged the window screen.

Once the bone layer (Level 2) was reached, excavations proceeded with shovels where possible, and with trowels, grapefruit knives and paint brushes when the bone was more concentrated. It usually took three exposures of about 10 centimetres each to get through the bone level. The 10-centimetre exposure level was chosen mostly because this seemed to be the most manageable maximum depth to work with through bone deposits. It should be noted that it was not strictly enforced because of the nature of the bone bed. In some units, the bone was so compact that several thinner exposures were required.

Bones and artifacts were mapped in and removed by each exposure and quadrant. Black-and-white photographs and slides were taken of units with some significance, and of all mandibles *in situ*. The mandibles were photographed because root growth had shattered most of them completely. It was hoped that a photographic record of each mandible would assist the analyst. Overall, this excavation procedure seemed to be time-efficient, as it was much easier to remove remaining quadrants once the first one was out. The depth of each exposure and stratigraphic level was also recorded. Once the top of Level 3 (the sterile substrate) was reached, the unit was taken down another 30 to 50 centimetres by shovel. This soil from Level 3 was also screened.

The main area of excavation consisted of a 15-metre trench which ran from west to east (Figure 1.5: Area B), from 104S 91E to 104S 105E. This particular area was chosen because the testing had revealed an extensive undisturbed bone bed here. The trench was widened form 103S 95E to 103S 100E. A shorter trench was set out in a north-south direction from 103S 95E to 101S 95E. The trench method was chosen for two reasons. First, Phenix had completed an area type excavation that was well-mapped. There was, however, little information in his records in regard to the stratigraphy of the site. A trench excavation would provide that data. Second, we had to contend with some logistical considerations. The Saskatchewan Archaeological Society had agreed to have their annual Field School at the Melhagen site. Since we were expecting at least 30 volunteers, it was felt that they would work best if spread out. Thus they were placed at every other unit along the trench, and worked in pairs. This arrangement proved to be fairly efficient, as the volunteers could be easily monitored and assisted.

Four more units were opened in a checkerboard fashion along the far west (Area C) fence in September. The previous testing had shown that the bone there was in much better condition than that which was produced in the trench area and the east side of the site.

The SAS volunteers also searched the surrounding area for signs of additional sites and find spots. One area was found about

215 metres to the southwest of the site in a depression. They collected several coarse-grained quartzite flakes. A Knife River flint retouched flake was found at 200N 160E. Local visitors reported that the field across from gate at the main grid road (some 2.3 kilometres to the north) had been a favorite collecting spot for years. We conducted a quick survey of this field after it was harvested, and found only a few weathered bone fragments and a couple of flakes. One visitor showed us a Knife River flint Besant point he had found on his way in at the access gate. These factors led us to believe that several sites and find spots could be found throughout the pasture.

The author, Urve Linnamae and the field assistant surveyed in the elevation of the site from a benchmark located by the grid road north of the site. After this was established, a contour map showing the present topography of the site area was drawn up by Linnamae (Figure 1.4). Soil samples for the flotation study (Chaper 2) were also taken during this field season.

b) Laboratory Methodology

Lab work in 1986 concentrated on two things. First, the Phenix materials were cleaned and sorted at a preliminary level. Most faunal materials were washed, unless it was evident that this would lead to the further disintegration of the bone. In cases where they were very fragile, the bones and teeth were simply dry brushed. If tags were still present and legible, they were saved and the information on them was recorded on new bags and in a journal. This process was extremely time-consuming, so the field assistant continued this task and eventually completed it on lab days in the summer.

The second priority was to complete a summary of the materials excavated in the 1986 field season. All of the materials excavated in 1986 were dry-brushed and weighed, and the results were provided in a preliminary field report (Hall 1987: 28-31). Cataloguing did not begin until the summer of 1987.

4.2.3) Research Summary of 1986

Twenty-nine one-metre units were excavated, and 70 test pits were dug in the 1986 season. Thus, 46.5 square metres in total were sampled. Over 230 kilograms of faunal material, 19 kilograms of fire cracked rock and almost 1.5 kilograms of lithics were recovered (Hall 1987:31). Nineteen diagnostic projectile points and/or point bases were recovered, as well as six point body or tip fragments (catalogued as bifaces) and one point preform. All of the diagnostic points represent the Besant culture period, except for one possible Pelican Lake point that was crudely manufactured from silicified peat. One of the points had been refashioned into a graver. Of the point and point fragments, nine were made from Knife River flint, and of these, seven were patinated. The rest were made from locally available materials. Nine end scrapers, two side scrapers and one Knife River flint drill preform were also found. Some of these unifaces were broken, and only two were made from Knife River flint. The remaining lithic collection from the 1986 season consists of retouched flakes and other miscellaneous broken tool fragments. No ceramics were found, but one shell disc bead was found in the western units.

In many ways the 1986 excavations confirmed several of Phenix's observations. The stratigraphy did appear to consist of one cultural level contained within four hillocks. Snail shells and ostracods were found within the bone layer. Moreover, the distributional pattern of the projectile point styles strengthened Phenix's observation that the length of the points decreases from west to east, and that there is a difference in the amount of local materials used across the site. However, Phenix had surmised that the apparent single cultural level visible in the stratigraphy meant that there was only one kill event. Yet the fact that there were several separate bone bed areas, and the fact that there were obvious difference in lithics put this in some doubt. It was thought that a seasonality study could address this problem.

The excavations also revealed other patterns. For instance, the bone on the western edge of the site was in much better condition than that recovered on the eastern side or in the trench. Bones from the west were often almost complete, and displayed a denser distribution (Hall 1987: 32). There were spots where vertebral columns had been laid over one another, with the proximal rib ends still attached. This sort of butchering pattern was not seen in other areas, as bones were largely disarticulated and jumbled.

Lithic artifacts seemed to show a different distribution. Preliminary results in 1986 showed that the lithics averaged 1.78 grams per quadrant on the west side, as compared to the eastern average of 74.82 grams per quadrant. A similar pattern was seen in the distribution of fire cracked rock.

In conclusion, it can be said that the goals of the 1986 field season were either met, or were well on their way to being addressed. It was also clear that the field work revealed some problems in the underlying assumptions of the original goals, specifically that which dealt with evidence of ceremonialism. This evidence was simply not found. Furthermore, problems were encountered in the reconstruction of the paleoenvironment. Several questions were raised in regards to the presence of the slough. It was not known if the slough was present at the time of the kill, or if it had formed afterwards. If it was present at the time of the kill, it would have no doubt affected the hunting strategy of the Besant people, perhaps as an integral part of the hunt. No definite post holes were found in either the Phenix or the 1986 excavations, so it could not be said for sure if a coralling method was used. Also, it was not known if more sites were associated with the Melhagen kill site. For these reasons, it was decided that a second field season was necessary at the Melhagen site.

4.3) Current Research: The 1987 Excavations

4.3.1) Research Goals of 1987

By the spring of 1987, the following research goals were set out:

> (1) To conduct a surface survey of an area one square kilometre in size around the Melhagen site in order to find any associated features, camp or kill sites,
> (2) To do some further testing and assessment of the kill area at the site,
> (3) To conduct a field and laboratory assessment of the geomorphological and postdepositional history of the Melhagen site and surrounding area,
> (4) To do a detailed analysis of the faunal material collected from the site in previous excavations(Hall 1988: 15).

4.3.2) Research Methodology of 1987

a) Survey Methodology

The field work commenced in May 1987. The following discussion is based on Hall (1988). A baseline from the 100S 100E datum point on the Melhagen site was surveyed in. The line extended 500 metres in each direction from the datum. Thus, a grid of one square kilometre in size was set out around the site (Figure 4.1). The initial line direction was established with the aid of a theodolite mounted on a tripod, and distance was established with a 50-metre measuring tape. Pins were placed every 100 metres on the grid. Twenty of the pins were established with instrument accuracy. The remaining 101 pins were set out with the use of a compass and distance pacing. The field workers stared at an instrument-established stake and paced off 100 metres in the appropriate direction in order to place the next pin.

This method was relatively successful, as the distance was accurate within 10 metres. Some problems were encountered, however, with the angle at which the field workers would set off. Thus, some of the units staked out resembled trapezoids more than squares. Nevertheless, considering the difficulty in maneuvering through the extremely dense vegetation in some areas, there were few problems with this methodology.

Once all of the 121 stakes were in place, the entire area was split into four equal quadrants along the 100S and 100E base lines. Each quadrant consisted of 25 units of 100 square metres each, and each were assigned a number from one to 25. The 100-metre square unit immediately adjacent to the datum stake was automatically designated for surveying in order to include the area immediately around the site. Five more units were chosen out of each quadrant by a random draw of a number. Thus, six units in each quadrant were chosen to be surveyed. Of the possible 100 units, 24 were surface surveyed by foot, thus sampling 24% of the one kilometre square area around the site.

The survey was conducted by the author and her field assistant. They walked five metres apart back and forth across the unit, collecting, mapping and recording all archaeological surface finds. Only two surface finds were discovered: a Knife River flint drill was found in a cattle trail at 250N 505E, and a chert core was found in a gopher backfill at 210N 600E.

Since very few artifacts were found, it was decided that some subsurface testing would have a higher possibility of revealing associated sites. Thus a shovel test was conducted at each of the 100 metre survey stakes, with the result that 120 test pits were dug in all. The datum pin was omitted, as any digging would have destabilized it.

The shovel testing was done with a two-person team. One person dug a hole with a long-handled spade, and the dirt was sifted through a portable screen onto a plastic tarp. Artifacts found in the screen were placed into labelled bags. In most cases, the holes were dug to a depth of one metre, as this was the deepest that the spade could reasonably reach. When bones or lithic items were found in sufficient quantity to indicate that they may be archaeologically significant, or if a dark paleosol was encountered, then test holes were dug on north-south and east-west lines every five or ten metres to find the approximate extent of the site area.

Measurements were taken of the depth of the cultural level or artifact level, and the depth of each test unit was recorded. Altogether, the subsurface testing revealed two more areas that had substantial black layers: one at 100S 200W and one at 300S 0E.

The depression located south of the site (near 215S 0E) was also shovel tested. This area proved to be a blown-out basin lying between the arms of a remnant parabolic dune. Six holes were dug here, but no cultural horizon was found. All bone and tooth fragments and flakes recovered from here were found either on the surface, or else within 10 centimetres of it. All of the surface find spots were located on gravelly textured soil. This has proven to be a significant feature in the reconstruction of the paleoenvironment and post depositional processes affecting the site.

b) On-Site Testing and Excavation Methodology

The remainder of the field season was spent testing and excavating on the site. This was done in order to find out exactly where the edges of the bone deposits were, and what sort of information they could reveal about the post depositional processes at the site. From the 90S 120E line (Area A) test pits were dug west, and south from this point. The line running north along 95E in Area B was also extended another two metres. The trenches were extended in these three places in order that more information could be obtained about the nature of the bone bed edges. The distribution of artifacts well past the black paleosol northward towards the center of the site, for example, indicated that some degree of deflation had occurred in the central area (Hall 1988: 25-26).

Once this task was completed, it was decided that further testing was not necessary. Little more information could be gained from continued excavations.

c) Cataloguing and Preliminary Analysis Methodology

All of the materials excavated from the site in 1986 and 1987 were washed, sorted, identified, weighed and catalogued by the author at the University of Saskatchewan in Saskatoon. Faunal and lithic materials were identified with the aid of comparative collections in the Department of Anthropology and Archaeology. The first attempts to catalogue were made on an Apple IIC™ computer. This proved to be a frustrating endeavor, as the computer was simply not powerful enough to handle the very large data base. With the assistance of David Kelly, a catalogue system was set up on an IBM™ personal computer using DBase III™ with a hard drive. These files were later duplicated onto a menu-driven DBase III+™ program.

As the faunal materials were catalogued, long bones and long bone fragments were set aside to be measured, in order to complete the gender profile of the herd. Bone tools, and bones which exhibited evidence of chewing and butchering marks were also set aside for further analysis. Lithics and teeth were boxed separately from the rest of the collection so that they could be more readily retrieved.

After the provenience of the materials were entered into the computer, they were identified as to whether they were faunal, lithic, organic or ceramic in origin. The next category was their "material type," which specifically designated whether the artifact was for example; bone, burned bone, or Swan River chert, or charcoal. The "form" was then described for the faunal elements as being a fragment, complete, almost complete, or if there were a group of fragments. For lithic artifacts, the "form" referred to whether, for example, it was a flake, debitage, or tool type. Faunal species were given where it was known. Miscellaneous fragments that could not be identified to a species were designated as "unknown" even though there was a high probability that they were bison bone fragments. The "part" of the tool or faunal element was then described. If the element was a loose tooth, it was first named by the tooth name. Then the distinction between mandibular and maxillary was made at the "aspect" level of cataloguing. Mandibular and maxillary fragments that included the bone and tooth portion were designated under "part" as mandibular or maxillary, and then were identified as to the portion of the unit they included. The side of the faunal elements were identified where possible, and any comments or observations were noted under another column.

4.3.3) Research Summary: 1987

Although the surface survey did not produce any remarkable results, a few general observations were made that pertain to interpretations of the post depositional processes occurring at the site. At both of the find spots north of the Melhagen site area (Figure 4.1), and at the find spot south of the site, artifacts were found on top of coarse sand and gravelly textured soils. These were deflation areas where the fine grained sediments had been carried away, leaving behind the heavier sediments and artifacts. Bone and tooth remains do not preserve as well in these areas, as exposure to the wind and weather quickly erodes these materials (Hall 1988: 20, 23-24).

The two subsurface sites found in the survey were tested in order to determine their boundaries. The black cultural level found at 100S 200W (EgNn-5) was found to extend some 20 metres north and 20 metres south, and 40 metres east to west. Some small bone fragments were found up to five metres beyond the black cultural level in each direction. The depth of the cultural level measured from 28 to 47 centimetres below the surface. In all, 65.4 grams of faunal material (bone, burned bone and tooth) and 8.4 grams of lithics were recovered from this area.

Testing at 300S 0E (EgNn-6) revealed that the cultural area extended five metres south, 20 metres north, 10 metres west and 45 metres east of the pin. The depth of the cultural level was from about 55 to 95 centimetres below the surface. As above, no diagnostic artifacts were found here. The inventory from this site includes 203 grams of faunal materials and 79.1 grams of fire cracked rock.

No cultural horizon was revealed in the surface lithic scatter area located around 215S 0E (EgNn-7). Most of the artifacts consisted of coarse-grained quartzite flakes and little faunal material. The lithic materials totalled 971.4 grams, and the faunal materials totalled 58.1 grams. This site could represent a lithic reduction area associated with the Melhagen site. Much of the quartzite material is very similar to the quartzite material recovered from the eastern portion of the site. The other surface and subsurface find spots are relatively insignificant, and have been reported in Hall (1988).

On-site testing revealed some information about the bone layer edges. The north wall of units 90S 117E and 90S 118E (Area A) and the west wall of 98S 95E (Area B) show that the bone bed is ill-defined and splotchy in appearance. The south wall of the first two of these units, however, shows that the bone layer pinches out sharply, as it also does along the west wall of 93S 120E. Several bones and tools were found beyond the western edge of the 90S 117E-118E trench, while no artifacts were found beyond the southern edge of the 120E line trench. The profile of the bone layer also slopes upwards towards the south. These facts would seem to indicate that the bone edges were exposed to a complex series of events of erosion and deposition (Hall 1988: 25-26).

CHAPTER 5

Cultural Affiliation and Age of the Melhagen Site

5.1) Introduction and Background

The age of an archaeological site is usually determined through the analysis of traits and characteristics of the site, its features and its artifacts. The chronometric age for the Melhagen materials may be established through radiocarbon dating. Since cultural affiliation is determined through the more subjective analysis of artifacts, problems may be encountered. This is especially true when one attempts to place the Melhagen site within the complex and conflicting interpretations of Besant-Sonota definitions and relationships.

The Melhagen site has been previously identified as a Besant site (Dyck 1983; Phenix 1969). This conclusion was reached based on similarities with other components on the Northern Plains which had been identified as Besant. These included components at the Mortlach site (Wettlaufer 1956), the Long Creek site (Wettlaufer and Mayer-Oakes 1960), and the Richards site components (Hlady 1967). When Phenix's (1969) original report was published, the Sonota complex had not yet been defined. There are differing views concerning the definitions of Besant and Sonota, many of which derive from terminological problems. This raises the question of whether it is valid to separate Besant and Sonota, and if so, on what basis and at what taxonomic level: horizon, regional phase, archaeological complex or cultural tradition. It is thus important to first review the archaeological and theoretical basis for the original definitions of Besant and Sonota, in order to reexamine the status of the Melhagen site as a Besant site.

The Besant culture was originally defined by Wettlaufer (1956) at the Mortlach site. Besant occupations were found in levels 4A through 4D, and were largely recognized by their distinctive projectile points. These atlatl dart tips were characteristically,

> . . . short and broad with shallow side notches and a slightly concave base. This base is thinned by striking a number of flakes off the base running toward the tip. This practise is the cause of the slight concavity in the base and creates "lugs" or "tangs" at the corners of the base (Wettlaufer 1956: 44).

Subsequent excavations at other sites over the years showed that the base was not always concave. It was often relatively straight and sometimes convex. Smaller points termed "Samantha Side Notched," (Kehoe 1966: 838) were also found to constitute a portion of the Besant assemblage. These points, which were presumed to be arrow tips, essentially resemble a smaller version of the Besant atlatl point and are sometimes made on a flake with little retouch.

It has become evident that pottery is occasionally associated with Besant components. This was seen at Long Creek, Walter Felt, the Garratt and the Intake sites (Dyck 1983: 120). The Garratt site ceramics are especially significant since these are the oldest dated ceramics (1990 B.P.) in the Northern Plains (Dyck 1983: 120).

Not everyone has accepted the association of pottery with Besant. Byrne (1973) apparently considered the evidence of pottery from the Long Creek, the United Church and Avery sites. He concluded that, "there is not one single example of the undoubted association of pottery in a Besant phase occupation in the plains area north of the Missouri Coteau" (Byrne 1973: 449). He felt that the evidence from all of these sites was plagued by stratigraphic problems, and that only sites located south and west of the Missouri Coteau contained pottery that correlated with Besant occupations. These were in Byrne's (1973: 449) opinion, related to the Plains Woodland ceramic traditions, and not directly to Saskatchewan Basin pottery. He felt that the Morkin site ceramics from southern Alberta related to the Saskatchewan Basin ceramics. It is interesting to note, however, that he did not actually see the Walter Felt site pottery collection.

Not everyone agrees with his interpretations. Recent work at the Rafferty Dam Project by the Saskatchewan Research Council archaeologists along the Souris River has revealed strong associations of pottery with Besant sites. Sherds similar to Missouri-area Besant pottery were recovered from the Ratigan site (James Finnigan, personal communication 1991) and were in association with Besant projectile points. Stratified Besant components were also excavated at the Crane Site (James Finnigan, personal communication 1991). These produced Besant projectiles and end scrapers made largely of Knife River flint, and several body sherds that seem to conform to characteristics of Sonota pottery. According to Meyer and Rollans (1990), these sites, as well as evidence from the Biggar Bone site

(Gibson 1978: 15), Walter Felt, and the Mudrick Springs site, all indicate that pottery is present in Besant components in southeastern and central Saskatchewan. Meyer and Rollans (1990) feel that, with the exception of the Intake site pottery, all of the ceramics from these sites conform to the pottery from the Missouri-area Sonota complex.

The remains of a house structure were also partially recovered from the Mortlach site in the Besant level 4A. This structure was delineated by a series of post-holes which formed a small arc of a circle, which was estimated to be some 25 feet (7.62 metres) in diameter. Any evidence of a central hearth or support pole was absent, perhaps due to previous diggings in that spot by souvenier hunters. Wettlaufer concluded that the structure could represent either a house or a ceremonial structure, noting its similarity to other structures found in North Dakota (Wettlaufer 1956: 41-43). It has also been compared to the habitation structures found at the La Roche site (Hoffman 1968) in South Dakota (House 2, Area A, 39ST9). These houses are comparable to early Woodland complex houses, in which a post-in-ground framework was covered with bark or matting. The conical tipi was also used by the Besant peoples, and several rings have recently been excavated in Besant levels in Alberta and Saskatchewan (Brumley and Dau 1988; Finnigan 1981; 1982; Quigg 1986). These tipi structures were sometimes up to 9 metres in diameter (Dyck 1983: 113).

The Sonota complex was defined by Neuman (1975) in reference to a series of burial mounds along the Missouri River in South Dakota. The sites which provided the basis for the definition of the Sonota complex included the Stelzer, Swift Bird, Grover Hand, Arpan and Boundary Mound sites. With the exception of the Stelzer site, which also had a habitation component, all of these were burial mounds. The mounds themselves were:

> . . . manifested by clusters of one or more low, domed earthen structures ranging from 55 feet to 100 feet [16.76 to 30.48 metres] in diameter and with maximum apical heights between 1.4 and 7 feet [0.427 and 2.13 metres]. Erosion has taken its toll and there is evidence indicating that originally the mounds were smaller in diameter and greater in height. Characteristically, the tumuli were built on the edge of the first high terrace or bench overlooking a river and they may adjoin the camping area of their builders (Neuman 1975: 94)

All age categories and both sexes were represented in the burials, and most were contained within a single central subfloor pit. In rare cases, the individuals were deposited on the mound floor, or within the mound fill itself. Most internments were secondary bundle burials. The bones of the torso were articulated, and the appendicular elements and skull were purposely disarticulated and stacked beside it. Grave offerings were common in most burials, with no apparent discrimination against any particular age or sex category. Offerings included such things as pendants made from bear, beaver and human bones and teeth, and marine and freshwater shells. Beads were made of bone, marine shells, copper and fossils. Pigments such as hematite, greensand, magnetite and yellow ochre were also found, usually in the form of powdery deposits or small lumps. Buffalo offerings sometimes included complete or almost entire carcasses. This would seem to reflect the importance of the bison to these people, in both a spiritual and a practical context. The seasonality of the bison remains also suggested that the mound was constructed between the spring and fall when the ground was not frozen. Neuman suggested that it probably took several days (Neuman 1975: 88-95).

The projectile points contained within these sites were side-notched and comparable to Besant points. Most of these and other chipped stone tools were made from Knife River flint. Bone upright features were common, especially in habitation areas. A few ceramic pipe fragments were found. Pottery was manufactured with the paddle and anvil method and the shape was generally conoidal. No evidence of coiling was found. The exterior surface of the vessels was either plain, or else was more commonly cord-roughened. Decorations usually consisted of a single row of punctates or bosses parallel to and below the rim. One vessel at the Stelzer site also had a band of dentate stamps arched in a diagonal fashion under the row of punctates (Neuman 1975: 93).

Neuman felt that all of these features taken together allowed a valid definition of Sonota as a regional expression of the communal-hunting oriented Besant culture. Most sites described in the western range of the Besant peoples were camp sites, pound and jump kill sites, and as such, these were characterized by hunting and hide preparation tools, and very little pottery. The mound sites he studied in the Missouri River drainage system in the eastern Dakotas, however, contained a much higher number of exotic goods and ceramics. These mound sites, he felt, reflected influence from Hopewellian groups to the east and southeast of the Plains area. He suggested that this influence occurred as the Hopewellian people traded with the Besant people for highly valued commodities such as obsidian and Knife River flint (Neuman 1975: 96).

Reeves (1970a) attempted to define and interpret several Northern Plains cultural phases and traditions that existed between 1000 B.C. and A.D. 1000. He saw the TUNAXA tradition as a widespread hunting-gathering Northern Plains cultural tradition that consisted of a number of phases. One of these was the Pelican Lake phase, from which he suggested that Avonlea developed as a result of the diffusion of the bow and arrow from the west. The NAPIKWAN tradition appeared on the Plains at about the same time that the TUNAXA tradition underwent considerable change between A.D. 1 to A.D. 400 (Reeves 1983a: 184-185). The Besant phase of the NAPIKWAN tradition:

> . . . having acquired ceramics, habitations and burial practices through contact with Middle Woodland cultures, expanded physically to the Missouri Basin, briefly displacing the resident TUNAXA populace from parts of the Northern Plains. This physical and cultural domination was incomplete, however, and the TUNAXA tradition continued as the Avonlea Phase, which coexists in space and time with the Besant Phase of the NAPIKWAN tradition. Although much contact between the two groups occurred, each maintained its own cultural identity, and by A.D. 700-800, NAPIKWAN became dominant in the Saskatchewan Basin and TUNAXA in the Upper Missouri Basin. By A.D. 800-100 new phases and cultural traditions appear throughout the area (Reeves 1983a: 185).

Reeves (1983a: 140-141) defined the Besant phase on the basis of the following characteristics:

1. Low frequency of unnotched points (usually one type).
2. Besant Side Notched (atlatl) and Samantha Side Notched (arrow) projectile points. No stemmed forms and few of Pelican Lake Corner Notched points. Flake points are common.
3. Few discrete types of bifaces with modified hafting elements.
4. High frequency of asymmetric ovate bifaces.
5. High frequency of small, dorsally finished end scrapers.
6. Distinctive drill types -- pentagonal and triangular.
7. Absence of pointed unifacial flakes, domed side scrapers, and pointed unifaces; few bifacial choppers.
8. Rare and localized cord-marked, bossed, and/or punctated conoidal pottery vessels.
9. Presence of excavated basin-shaped earth-filled hearths but absence of excavated basin- or bucket-shaped rock-filled hearths. Surface hearths are common. Presence of cache pits, house structures (two sites), and bone uprights.
10. Secondary burials, usually accompanied by many grave goods, in a central subfloor log-covered tomb, under an earth mound.

It should be noted that this list of characteristic traits differs from his original one (Reeves1970a: 149-150) in the following ways. First, in the more recent edition he recognized the presence of the Samantha arrow projectile points under point number two. This was not stated clearly in the original dissertation. Second, he added the presence of house structures in point nine. Third, and quite significantly, he appended point ten, which would therefore include the Sonota complex burials as described by Neuman in the Besant phase.

In his foreword to this volume, Reeves updated the dissertation and addressed some issues that had arisen since it first came out. Much of his discussion was concerned with Syms' (1977) criticisms of

Reeves' work. The problem is largely derived from Syms' argument that Reeves did not really define a Besant phase, but rather a Besant horizon, since, "his criteria of identification was the presence of projectiles with shallow notches at the sides, which he called the Besant Side-notched and Samantha Side-notched projectile points" (Syms 1977: 91). Syms seemed to suggest that Reeves included too many different types of sites which are found in too wide of a geographical area to be considered as constituting a "phase." Syms may have a point here. Reeves did, even by his own admission, (1983: 39) stretch the definition of "phase" in the spatial sense of the word as it had been set out by Willey and Phillips (1958: 22). In their definition, phases are limited to localities or regions, but this is also a fairly loose definition. Reeves (1983a: 39) states that, in his scheme, "a phase does not necessarily correlate with a locality, region, or even an area. The area occupied by a phase may change through time and it may in fact be found in two environmentally distinct areas." If Reeve's redefinition of a "phase" can be accepted, then it is easier to accept his view of the relationship between Besant and Sonota. Some people do not readily embrace such tampering, and prefer to stick to traditional terminology.

Syms (1977: 90) ignored Reeve's terminology and reassigned the Muhlbach, Walter Felt, the Richards Kill site, and the Richards Village site to the Sonota complex. He did not feel that these sites were Besant because they shared characteristics that Neuman had noted as being diagnostic of the Sonota complex: the presence of vertical upright features, and more importantly, elongate projectile points with distinctive notches, and a high quantity of Knife River flint. He held that lithic materials from Besant sites (as he defined "Besant") were quite different, as there was a lower occurrence of Knife River flint, and the projectile points were, in his mind, short and squat with shallow notches (Syms 1977: 92). Having reclassified Besant as a horizon, Syms (1977: 92) then went on to suggest that "it is likely that Besant represents a separate *complex* that can be combined with the Sonota Complex at the level of a *composite or configuration* [italics my own]."

Syms therefore created what Reeves (1983a: 11) called "an artificial separation between Besant and Sonota." As Reeves noted, Syms ignored or omitted sites which have varying amounts of Knife River flint and projectile point lengths: "- the Kenny Site (Reeves 1966), Old Woman's (Forbis 1962) and 24HL101 [Wahkpa Chu'ga] (Davis and Stallcop 1966) for example" (Reeves 1983a: 11), not to mention Long Creek and the Mortlach sites. Furthermore, Syms' conclusions seem to have been reached through his examination of report illustrations, and not on any sort of quantified analysis, while Reeves claimed that his own analysis was "based on a 'hands-on' examination of all collections" (Reeves 1983a: 12), including the entire technological assemblage. However, it is important to note that Reeve's "hands-on" examination was still not a quantified analysis of individual artifacts. Indeed, if one glances at the Stelzer site Sonota projectile point illustrations (Neuman 1975: 153), over half of them could be considered as short and stubby, and hence, Besant. Of the 57 points described, only 33 are made from Knife River flint (Neuman 1975: 17-18).

Reeves (1983a: 11) suggested that since Besant has a historical "terminological precedent in the literature over Sonota (Wettlaufer 1956, 1960, Forbis 1962, David [*sic*] and Stallcop 1966, Gruhn 1971) the use of the term Sonota should be restricted to the mound burial pattern." Furthermore, the:

> Sonota Complex *senso lato* is the Besant Phase of the Northwestern Plains; *senso stricto* the Sonota Complex is the Besant Burial Mound complex of the Middle Missouri. I urge that the term Sonota at best be restricted to this burial mound complex" (Reeves 1983a: 13).

It is clear from the literature that while others do not necessarily agree with Reeves, they refer to Besant as a phase or complex, and not as a horizon.

Both Reeves (1983a: 12) and Syms (1977: 92) have rightly lamented over the lack of a proper systematic quantitative analysis of the variations within the phase. It is also apparent that Reeves and Syms did not fully consider that other factors may actually account for any "differentiation" between the so-called Besant and Sonota projectile point types. This author would therefore suggest that attributes and evidence of other factors be examined, specifically the frequency and location of use-wear and reworking. Some of these points may have been used as knives, and may have been broken and resharpened. If Knife River flint was a preferred material, it only makes sense that the Besant people would have taken steps to conserve it through intensive use, by resharpening and modification of tools made from it, especially if it was in short supply. The amount or degree of reuse of Knife River flint tools may be a reflection of the group's physical proximity to the quarries, or to an expected rendezvous time of trade with another group that had access to the quarries.

The idea that Knife River flint was not always available in a constant supply all over the Plains was put forth by Finnigan and Johnson (1984: 32), who suggested that "the so called extensive use of this material [during the Besant phase] has a restricted seasonal and/or temporal and/or distance-from-source aspect." They also correctly suggest that "the short points from this site [Elma Thompson (EiOj-1)] represent an adaptation to local lithic materials (Finnigan and Johnson 1984: 32). In other words, the physical properties of locally available lithics may have played a decisive role in the manufacturing technique and the resultant morphology of the projectile point.

It has also been pointed out that the activities carried out at a burial mound would be somewhat different from those carried out at a bison kill site (Johnson 1977: 36). The intensity and character of knife and/or projectile point usage and modification would be expectedly different. An in-depth study of the entire technological assemblages of all known excavated Besant and Sonota sites is clearly required.

In the consideration of the Melhagen site materials, we are faced with a dilemma when assigning cultural affiliation (Besant or Sonota) to the site. Reeves' trait list for Besant is only useful insofar as his Besant characteristics can be distinguished from Sonota characteristics, which this author does not feel have been adequately defined. Both Besant and Sonota projectile points seem to share a number of characteristics in technology and features, and no one has quantitatively distinguished them. In the end, the analyst who does assign a site to either Besant or Sonota simply on the basis of a few (mistaken) generalities such as Syms did, is in fact making a decision based on criteria that are conflicting, overlapping, and hence, unresolved.

This is even more apparent when the Melhagen site collection is examined. Photographs and drawings of the Melhagen site projectile points may be seen in Figures 5.1 and 5.2. A visual inspection demonstrates the wide variation in their size, morphology and lithic materials. Phenix's projectile point collection is comprised largely of elongate Knife River flint points. The 1986-1987 excavations revealed an assemblage which seemed to consist of shorter points made from a much lower percentage of this material. These excavations were concentrated in a different area of the site. This apparent differential distribution may actually lend support to the idea (following Syms) that the site was occupied by two different cultural groups: one Sonota (seen in Phenix's collection), and one Besant. Had Syms examined illustrations of Phenix's point collection, he would have undoubtedly called it Sonota. Its similarities to the Richards site materials (Hlady 1967) are remarkable. If he had looked at the majority of the materials excavated by this author, he would have called them Besant. If you follow Reeves, however, this distinction may not be valid. Also, since there is no burial mound complex evident at the site, it would be classified as a Besant site.

As noted earlier, much of the problem of distinguishing Besant and Sonota points rests on Syms' idea that Besant points are short, stubby, and made of local materials, while Sonota points are elongate and made mostly of Knife River flint. Such an assertion cannot be made on the basis of these general descriptions. It is the opinion of this author that the range of variation that Syms has perceived in Besant and Sonota assemblages is in fact normal, and may not necessarily be linked strictly to cultural differences. Other factors are just as important, such as the availability of raw materials, the ability of the flint knappers, the actual function or use of the artifact and how much it had been resharpened. Ideally, it would be desirable to conduct a quantitative analysis on material cultural remains (projectile points as well as other artifacts and features) from as many excavated Sonota and Besant sites as possible, and compare the Melhagen site data with the other data. This is a task too monumental to be done here.

At least one attempt has been made in the past to differentiate Late Prehistoric groups through projectile point quantification, (see Greaves 1982) but it suffers from its limited explanatory framework, primarily because the specimens analyzed clearly consisted entirely of arrow points. The fact that all of these were used in a single weaponry (the bow and arrow), automatically rules out functional explanations for variability in favour of cultural explanations. Furthermore, on the basis of Fawcett's (1980) work, she did not feel that lithic material types provide the necessary high level ratio data that was acceptable for her multivariate statistical techniques. It is quite possible that the inclusion of raw material data could have revealed some useful patterns, so perhaps it should not have been so summarily dismissed. Use-wear information or evidence of reworking were not included as possible contributing factors of point variation.

Reher and Frison (1980) also grappled with projectile point analysis in their study of the Vore site arrow points. Although they discussed at some length the importance of function in artifact classification, their study was again limited by the fact that all of the points were, in fact, arrow heads. Like Greaves, they still had to base their interpretations on explanations related to cultural differences rather than on differential artifact functions. The only functional explanations of variability dealt with the increasing size of the prey and the corresponding increase in the size of the points. In other words, a different size of bow and arrow would be used for hunting deer as opposed to bison. This is an idea derived from Kehoe's (1966) work and was previously alluded to in Frison's (1971: 82-83) Ruby site report. Such an explanation is problematic at a bison jump site where bison clearly and overwhelmingly dominate the faunal assemblage. Also, the range in size of arrow points is much narrower than that seen in Besant point assemblages, which may well have atlatl, arrow and spear weaponries. The Vore site arrow tips did become smaller over time, most likely as a result of changes in the bow size, strength and technology.

One positive aspect of Reher and Frison's (1980) study is that they did look at lithic materials in their analysis, and found that the points made from KRF tended to be larger than the others. They were perhaps related to an older technology which employed a different size of bow. This phenomenon was not well explained and should be looked at in more detail. In summary, it seems that the variation seen in the Vore site points are more strongly linked to cultural factors, including stylistic changes due to improvements in the bow and arrow technology, than they are to strictly functional differences.

The main contribution of the next section of this chapter is that it will provide a data set of some important measurements and features of the Melhagen site projectile points, and it will suggest a methodology that could be applied to further research which may involve several documented collections. It should be noted that the results of this study are preliminary in nature.

5.2) Projectile Point Study

5.2.1) Objectives

The first part of this analysis will be concerned with the examination of both the metric (quantitative) and non-metric (qualitative) projectile point data. The tools initially used in this analysis include all hafted tools that are estimated to be at least 50% complete. This has without a doubt affected some of the results, as there was no attempt to break down the collection into arrow points, atlatl points and hafted knives, and deal with each category separately. This was not done because it is often difficult to distinguish between, for example, large atlatl tips and small knives. It was also apparent that several of the atlatl tips had been used as knives.

The metric and non-metric data has been provided largely to meet one very important objective. That objective is to provide as much information as possible about the projectile point assemblage so that future researchers may have access to *useful and comparable* *data*. The fact that no researcher to date (to this author's knowledge) has conducted an intersite statistical comparison of Besant and Sonota point assemblages should come as no surprise. The sheer volume of work involved would be overwhelming. If information is provided at all in publications, it is usually displayed in a table including minimum and maximum measurements of length, and/or width, and/or thickness and/or weight, and perhaps some cursory reference to material type and base shape (see Gruhn 1971; Hlady 1967; and Neuman 1975 for a few examples). This makes it impossible to compare information from one site to the next.

The second objective is to examine the data from this site and make comparisons with information from other Besant and Sonota sites. This is a difficult task considering the aforementioned problems. Thus, much of the comparative discussion is limited to general statements with little statistical basis.

The third objective of this section is to see if two separate occupations are statistically reflected as distinct groups within the Melhagen projectile point assemblage. More importantly, it is necessary to statistically establish the criteria, or (groups of) quantifiable attributes that allow this separation to be made. If no distinct culture groups can be isolated within the data, then it may be suggested that the collection represents a normal range of variation within a culture group. General patterns may be discernable within this range of variation, however, based on the relationships between and within particular sets of metric and non-metric attributes. These patterns may support the idea that more than one group occupied the site. On the other hand, these patterns may be more closely related to site activities, use of projectile points in butchering activities, or broader factors such as group access to preferred raw materials and the flint knappers' ability to work with particularly "difficult" raw materials. At the very least, the purpose of this portion of the study is to define the variables that are most important for distinguishing patterns within the assemblage. Although this study is preliminary in nature, it hopefully will enable future researchers to concentrate on the most promising avenues of investigation, to refine the methodology and to apply it to a wider scope of investigation that should include several Besant and Sonota site collections.

5.2.2) Methodology

Two sets of data were collected for each projectile point: one based on metric attributes (quantitative) and another set based on non-metric (qualitative) attributes. The raw data from each is displayed in Table 5.1 and Table 5.2 respectively. In order to prevent inconsistencies in the data collection, one person conducted both the metric and the non-metric analyses. The analyst, Charles Ramsay, verified the results by double checking them.

The first step was to determine the dorsal and ventral surfaces of the point. The method used for this was drawn from the author's and the analyst's combined experience in teaching labs in artifact analysis at the University of Saskatchewan. The dorsal surface of the point was that which was more rounded when observed in cross section. Generally the dorsal side was also flaked more skillfully than the ventral side. In a few cases where the dorsal side was not obvious, an arbitrary decision was made. This may have introduced a source of error into the analysis, but few points required this arbitrary decision. The point was then held dorsal side facing up with the base towards the analyst, and the tip pointing away. The left side was on the left of the analyst, and the right side on the right of the analyst.

Measurements (see Figure 5.3) were taken with a pair of calipers and were recorded to the nearest tenth of a millimetre. No angle measurements were taken since we did not have access to the appropriate instruments, but these could be included at some future time if further research requires it.

The measurements chosen were basically restricted to ones used by archaeologists at the Saskatchewan Research Council (Finnigan *et al.* 1985), with the methodology and terminology that had been suggested by Binford (1963). The qualitative descriptive terminology and methodology was also drawn from Binford (1963) and Reeves (1970b), although several categories were inappropriate for the purpose of this analysis, and were omitted. A modification was made to the measurements of body length, notch height, notch depth and basal height. These were made on both the left and right sides because several of the points were obviously asymmetrical in their shapes and therefore also in these measurements. This decision proved to have some interesting results. In cases where there were broken tips, shoulders or bases, the mean value was substituted in the metric data set (Table 5.1).

The statistical data was largely handled by Dr. John Sheard at the University of Saskatchewan. There are several types of statistical techniques that could have been used for this study, including any one of several methods of factor analysis and cluster analysis. Cluster analysis may have delineated different groups or clusters within the point collections. However, this method has two major problems. The first is that these methods will impose patterns on data. It is up to the researcher to decide if these patterns are meaningful or not. Second, because there are several types of cluster analysis, it is probable that different methods will produce different results when applied to the same data set (Shennan 1988: 228).

At this stage, Sheard and the author were uncertain if distinct groups were represented within the collection, or if the considerable variation within it actually represented a continuum. Cluster analysis would, therefore, be inadvisable as it would impose groups on the data even if they were inappropriate. Because of these circumstances it was desirable to apply a factor analytic method. The simplest of these is Principal Component Analysis (PCA), because it makes the fewest statistical assumptions. As Doran and Hodson (1975: 196; in Shennan 1988: 261) have stated:

> 1. It gives a helpful indication of the relationships between variables [measures].
> 2. It also provides information about the relationships between units [samples or objects].
> 3. It suggests whether there are any major trends behind [or within] the raw data, and which variables are mainly involved in the trends.
> 4. It provides a transformation of the data in which in general a very large percentage of the variation in a large number of variables is compressed into a smaller number of [new] variables.
> 5. The transformation effected is such that the new variables are uncorrelated with one another

Since these characteristics seemed to match the objectives of this analysis, it was decided to proceed with PCA.

After all of the points were measured, three of the artifacts (Catalogue numbers 917, 2242 and 6307) were dropped from the PCA because they each lacked half of the measurements. These artifacts were still retained in the qualitative analysis. Once all of the available measurements were recorded, an average value was calculated for each attribute (Table 5.1). This value was then substituted for the missing values (Table 5.3). By doing this, we were able to include as many artifacts as possible in the analysis without changing the average value of the measured attributes or biasing the analysis.

There are other approaches that could have been taken to deal with the missing values. One alternative is that the artifacts with missing values could have been dropped from the analysis entirely. This would have affected the analyses in at least two ways. First, it would have shrunk the sample size. Second, it would have eliminated several of the longer points which are most susceptible to breakage on impact.

The non-metric data is summarized in Table 5.4. Some of the attributes in this table were later coded with letters in order to combine them with the qualitative data for the final analysis.

The metric values were analyzed by the procedure FACTOR, SPSS-X 3.1, installed on a VAX 6330 computer at the University of Saskatchewan. Fifty three (53) points were used in the analysis. Of these, 40 were from the Phenix collection, and 13 were from the Ramsay collection.

5.2.3) Analysis

a) Summary of the Metric (Quantitative) Data

Fifty seven percent of the Phenix projectile points were considered as "absolutely complete" while 41% of the Ramsay points were considered as "absolutely complete". Such points did not have any missing tips, shoulders, bases, or body (blade) parts. The remainder of the Phenix collection consisted of points that still were complete enough to be used in the metric analysis, while three of the Ramsay points had to be dropped due to incompleteness of form. In these cases, at least half of the measured values were missing.

The raw metric data may be found in Table 5.1. A summary of the measurements is located in Table 5.3. This table was determined from all of the data, omitting only the missing values. It is interesting to note that the left side measurement means are all equal to, or greater than the mean of the corresponding right side measurement. The reasons for this are not entirely clear. There is a remote possibility that this is mere coincidence, but this seems unlikely. This author would rather favour an explanation which involves the "handedness" and motor patterns of the person(s) who manufactured and/or reworked the tool. Many of the points are obviously asymmetrical in outline as a result.

It would be desirable to compare metric data of the Melhagen site with several Besant and Sonota sites. The author has run into one major obstacle here, in that the data required for such comparisons is lacking in most of the relevant published site reports. For example, the Mortlach (Wettlaufer 1956) and the Long Creek (Wettlaufer and Mayer-Oakes 1960) site reports provide absolutely no metric data and very little information on the projectile point assemblages. This has meant that other workers must obtain these collections if they wish to get any information from them at all. For example, Reeves studied both these collections and compared them with the Kenney site materials, but it seems that the raw data was dropped from the Kenney site report (Reeves 1983b). The problem with this is that researchers end up repeating work that has been done by others. The positive side of this is that it provides a way to double-check each other's work and methodology.

Nevertheless, some basic information that actually does appear in publication can be used here. One of the few site reports which covers the metric data in any sort of comparable fashion was produced by Reeves (1983b) on the Kenney site. This site in southwestern Alberta is a stratified campsite which contains three major occupations, one of which is Besant. Layers six and eight contain Besant artifacts. It seems from Reeve's summary that the projectile points in Layer six (the more recent occupation) are smaller overall than those recovered from Layer eight. There are problems with the radiocarbon dating results which make it difficult to interpret the temporal separation between the layers. There is also a striking absence of Knife River flint at this site. Reeves did measurements on both the right and left projectile point notches. It is significant that asymmetry in these measurements appears in the Kenney site collection. In both layers, the left notch depth average (L6=2.33 mm; L8=2.19 mm) is greater than the right notch depth (L6=2.31 mm; L8=2.09 mm), and the left notch height average (L6=5.82 mm; L8=6.85 mm) is less than the right notch height

(L6=6.58 mm; L8=7.18 mm). In the Melhagen materials, the left notch depth average was the same for both sides (2.60 mm), and the left notch height (7.90 mm) averaged greater than the right notch height (7.50 mm).

The overall size of the Layer 8 points is greater than the Layer 6 points. This is seen in the average maximum length (L6=23.75 mm; L8=27.86 mm), which ranges between 17 mm and 30 mm in Layer 6, and 13 mm and 51 mm in Layer 8. The average body width measurement in Layer 6 (16.31 mm) is also less than its counterpart in Layer 8 (19.13 mm), although the ranges are quite similar (L6=13 to 22 mm; L8=13 to 25 mm). The average width at the base in Layer 6 (16.65 mm; range of 9 to 21 mm) is less than the average base width in Layer 8 (17.38 mm; range of 10 to 23 mm). Thus the widest portion of the points also differs between the layers. In the Layer 6 artifacts, the maximum width is evidently found more at the base, while in Layer 8, the maximum width is usually found at the shoulder. The average neck width in Layer 6 (12.47 mm; range of 9 to 18 mm) is also less than its counterpart in Layer 8 (14.85 mm; range of 12 to 20 mm). In these respects, the Melhagen materials seem to resemble the Layer 8 artifacts more than the Layer 6 ones, although the Layer 6 points definitely fall within the Melhagen collection's wide range of variation. Except for the measurement of maximum length, the range between minimum and maximum values of the attributes is virtually the same for all of these collections. The much larger range of variation seen in the Melhagen points is no doubt a result of the inclusion of the large hafted spear and knife tips.

The Muhlbach site (FbPf-100) in south central Alberta is a bison kill site that is similar to the Melhagen site. Unfortunately, the only published information on the site is in the form of a preliminary report (Gruhn 1971). An analysis of the projectile points was apparently carried out by Reeves for his Master's thesis, which formed the basis of his Kenney site report (Reeves 1983b). The raw data from the Muhlbach points was omitted from this report, as was other comparative data. In the preliminary report, Gruhn discussed the bifacially flaked points separately from the unifacially flaked ones. She did not give any sort of detail, reporting only the ranges in dimensions and omitting the number of points accounted for in each attribute, and their average values. The information from the bifacially and unifacially worked points will be combined in this discussion for the sake of brevity.

The Muhlbach points display much of the range in size and overall morphology as is seen in the Melhagen collection. The maximum length of the Muhlbach points ranges from 21.0 mm to 66.0 mm, which is slightly less than the Melhagen points, but is still larger than those recovered from the Kenney site. The basal width ranges from 8.0 mm to 22.0 mm, while the body width ranges in size from 9.0 mm to 26.0 mm. These dimensions are again slightly smaller than the Melhagen points, but the maximum body width measurement is the same. Neck widths range from 9.0 mm to 18 mm, and the notch height ranges from 3.0 mm to 12.0 mm. No measurements for the notch depth were reported. Smaller point dimensions usually fall within the unifacially worked flake points. This is to be expected since most of these would have been manufactured from a relatively thin primary flake, and perhaps with some degree of haste (Gruhn 1971: 142). Overall, the Muhlbach site projectile points seem to fall between the Kenney Layer 8 and the Melhagen site points in size. Without better data, it is difficult to make any more detailed statements regarding the Muhlbach projectile point metrics.

The Ross Glenn site (Quigg 1986) in southeastern Alberta is a Besant campsite with tipi rings and pottery. It has been radiocarbon dated to 1455 B.P. Of the 12 Besant points recovered, only four have all the measurements we have discussed. This small sample size does make it difficult to make statistically valid comparisons, but a few statements can still be made. Without going into the detailed metrics which are available in publication (Quigg 1986: 176-177), it is clear that these points are closely related in size and form to the Kenney site Layer 8 materials, and to those Melhagen points that are made of local materials. Again, the length average is less at the Ross Glenn site (28.7 mm) than at the Melhagen site, while the width dimensions are virtually identical to the Kenney site points. The maximum width of the Ross Glenn points seems to be located at either the shoulder or at a wider place along the body.

The Richards Kill site (Hlady 1967: 3-10) is much like the Melhagen site in that it is located in a similar environmental zone and is also a kill site. As mentioned before, this site was defined as a Besant site by Hlady, but was reclassified by Syms as a Sonota site despite the fact that no burials are known to be associated with it. Unfortunately, the published information on this site is somewhat limited in its approach and outmoded in its content. The mean maximum length of the Richards Kill materials is 45.5 mm, with a range from 25.0 mm to 72.0 mm It is important to note that these figures were calculated largely from estimated lengths, as only six of the points were complete. Despite this, it appears that the average point length could have been slightly longer than the Melhagen materials, although the ranges are, for all purposes, exactly the same. The mean maximum width of the Richards Kill site points was 21.2 mm with a range from 16.5 mm to 25.0 mm. Thus, the Melhagen points have a slightly larger range of variance in this respect. The maximum basal width ranged from 14.0 mm to 21.5 mm, with a mean of 18.7 mm in the Richards Kill site materials. In comparison, the Melhagen points are, on average, wider at the base. No information regarding the notch dimensions appears in Hlady's report.

In order to see if there are any differences between Besant and Sonota point metric attributes, it is necessary to compare data with known Sonota sites. Neuman (1975) used several sites to define the Sonota Complex. All of these were burial sites, except for the Stelzer site, which had a habitation component. He discussed the projectile point data in more detail than many other analysts, but still did not provide the actual data used in his summaries. Neuman divided the projectile points into groups based on their morphologies, and then listed the minimum and maximum lengths, widths, thicknesses and weights of each group. The Stelzer site (39DW242) yielded the most point type groups. Overall, the maximum length measurement ranged from 26 mm to 67 mm with a range of 41 mm, while the maximum width ranged from 18 mm to 29 mm with a range of 11 mm. Thus the point lengths seem to measure slightly less than the Melhagen site and Richards Kill site points, and have a slightly smaller range of variance. It is not clear if the maximum width measurements were taken at the base or at the shoulder. These points are slightly wider than the Melhagen points. The thickness ranged from four to 9 mm, and the points weighed between 2.7 grams and 8.8 grams. No means were provided in his analysis (Neuman 1975: 17-18).

The information from the remaining sites he examined was presented in the same way. It would serve little purpose to list the ranges of point sizes for each of these sites, since each yielded few specimens. Overall, the maximum length ranges from 16 mm to 71 mm. The maximum width ranges from 13 mm to 32 mm, and thickness ranges from three to nine millimetres. The weights of the points ranges from 0.5 grams to 13.6 grams. The largest length, width and weight measurements come from a specimen from the Grover Hand site (39DW240) (Neuman 1975: 50-51), and the smallest measurements come from a single specimen from the Arpan Mound site (39DW242) (Neuman 1975: 62).

The only easily accessible publication that contains a good range of comparable data is that from the Naze site (32SN246) (Gregg 1987: 277-280), a multi-component site located on the James River in North Dakota. The Sonota complex deposit here dates between 40 B.C and A.D. 70; dates which are perhaps slightly older than the Melhagen site dates. The evidence indicates that the site was used as a bison butchering and processing site on several occasions. Gregg (1987: 268) referred to this site as a Sonota complex site because he felt that the materials (pottery and lithics) resemble Sonota materials more closely than Besant, and because the term is more commonly used in the Northeastern Plains region. He still referred to the projectile points as Besant Side-Notched and Samantha Side-Notched, largely because of the historical precedence of these terms in the literature.

Twelve Besant points were recovered here, as well as one Samantha point and two large corner-notched points (Gregg 1987: 277-280). Notwithstanding the fact that the Naze site represents a different type of site (processing site) from the Melhagen site (a kill and primary processing site), and the fact that they are located in different environmental zones, the projectile point data merits some comparative discussion.

The Samantha point from the Naze site is almost identical in basic measurements to one recovered from the Anderson Tipi Ring site (Deaver 1985: 71 in Gregg 1987: 280). Of the Melhagen points, one recovered during the 1988-87 excavations could be considered as a Samantha point. Artifact #3021 was recovered from the central trench area, and was manufactured from poor quality Knife River flint. The tip is broken, and the estimated length is close to 18.3 mm. This point is slightly shorter than the Samantha point from the Naze site (22.7 mm), and its width measurements at either the base (13.4 mm) or at the shoulder (11.6 mm) do not vary significantly. Gregg suggests the Samantha point from the Naze site was used not as an arrow, but as an atlatl dart tip. Such small and fast atlatl darts were apparently common in Early Plains Woodland weaponry in the

Northeastern Plains area. Artifact #3021 could also have been a small atlatl tip, but that is a question that cannot be resolved here.

The dimensions of the remaining Naze site points compare well with the Melhagen materials. The maximum length mean of the Melhagen collection is about 10 mm longer than that of the Naze site (a mean of 30.2 mm) primarily because Gregg was only able to use four complete points, and he did not include the large corner-notched knives in the analysis (Gregg 1987: 279). As a consequence, the minimum range of maximum point length in the Naze site material was 25.1 mm and the maximum range was 36.0 mm. This makes comparison a little more difficult, but the four complete points are certainly similar in size to the Melhagen points. This is reflected most strongly in the means and ranges of maximum thickness, shoulder width, maximum base width and notch depth. Judging from the statistics Gregg provided, it would appear that the maximum width usually occurred at the shoulder. The width measurements here ranged from 18.2 mm to 24.2 mm, with a resulting range of 6.0 mm. The mean of the shoulder width measurements was 21.4 mm, which is again comparable to the Melhagen mean of 21.5 mm at the shoulder. The notch height measurement is slightly different between the two site collections. Although the minimum notch height is the same (3.6 mm), the maximum range is greater in the Melhagen materials (12.5 mm) compared to the Naze site materials (7.5 mm). This is due to the fact that the rather large measurements come from the points with the largest overall size; ones that could be considered as spear tips or knives on the basis of size alone.

In summary, it seems that the points from the more eastern kill sites are larger overall than those in Alberta kill sites, and larger still than those recovered from Alberta habitation sites. Size, however, does not tell the whole story, and so it is important to look at the non-metric, or qualitative information in order to understand the variation in the Besant projectile point assemblages.

b) Summary of the Non-Metric (Qualitative) Data

Table 5.2 contains all of the raw data for each of the projectile points studied in this analysis, including ones that were later dropped from the metric analysis. Table 5.4 has summarized this data into a format that may be discussed with some ease. As was the case with the metric data, it is still difficult to make comparisons with other sites where such data is not reported.

All of the projectile points and hafted knives are diagnostic of the Besant culture, with the possible exception of one possible Pelican Lake point. This artifact (Figures 5.1 and 5.2: #4469) was crudely fashioned from heat-treated silicified peat, which is a difficult material with which to work. The way in which the notches have been fashioned gives the point a corner-notched appearance which is more diagnostic of the Pelican Lake complex than Besant. Since the left basal edge is broken, it is difficult to say if the original or intended form was indeed corner or side-notched. The point was found at the very bottom of the occupation layer, and may have been lying there prior to the time of the bison kill, or may actually have been used in the Besant kill event. Silicified peat debitage was certainly well-distributed over the site and is locally available. For the purposes of this discussion, we will consider this as a Besant point without ruling out the possibility of its Pelican Lake affiliation. Pelican Lake points are not uncommon at Besant sites, although they usually appear in low frequencies. They have been recovered from firm Besant occupation contexts at the Ruby site (Frison 1971:82), the Naze site (Gregg 1987: 274, 278), and the Stelzer site (Neuman 1975: 153). Reeves (1983a) has suggested that this could be due to some interaction between Besant people and neighbours who used corner-notched points. Middle Woodland people in the upper Midwest area who used corner- notching 2,000 years ago are good candidates (Gregg 1987: 278).

As has been noted previously in this thesis, a large proportion (78%) of the Phenix projectile point collection is made from Knife River flint (KRF), while 52% of the Ramsay collection is made from KRF. Some of this disparity may partly be a chance result of the smaller size of the Ramsay collection. Overall, KRF comprises 70% of the entire projectile point collection. Other important materials include Swan River chert (SRC) (11%), and lesser proportions of chalcedonies (mostly brown and some mottled or white), chert, black pebble chert, jasper, silicified peat and fused shale.

The Muhlbach site projectile point collection is also comprised of a large amount of KRF. Of the bifacially worked points, 89% (36 points) are made out of KRF, "the primary source of which is in North Dakota, although the material has also been found in river gravels in southern Manitoba [according to Hlady 1965]" (Gruhn 1971: 142). Of the unifacially worked points, 84% (25) are made from KRF. Other materials at the Muhlbach site consist of chalcedonies, silicified wood, black chert and grey quartzite.

Knife River flint is also found in high proportions in the Wahkpa Chu'gn site in Montana, along with some "atypical cherts" (Reeves 1983b: 58). Reeves (1983b: 58, 62) also has reported that the Mortlach site points are made mostly from KRF, and the points from the Long Creek site are made from KRF. The Richards Kill site projectile points consist of 56% KRF and 35% brown chalcedonies. The Ross Glenn projectile points totally lack KRF, as do the Kenney site points. Frison (1971) did not discuss the projectile point raw materials found at the Ruby site. As was previously mentioned, the Stelzer site projectile points consist of 42% KRF (24 of 57 points). Knife River flint comprises 58% (7 of 12) of the Naze site projectile points.

Ovate body shapes dominate both of the Melhagen site collections, and contracting-ovate is the next most frequent shape. Some points have excurvate edges on one edge and incurvate edges on the other. This is indicative of projectile point reworking and resharpening. One point (#10868) is reworked on both edges so that they were slightly concave. The majority of the points in both collections are asymmetrically shaped, with only 21% of the entire collection symmetric in outline.

This pattern is also seen in the Muhlbach site points, in which 89% of the bifacially worked points and 92% of the trimmed flake points have a convex body, while10% and 8% respectively have straight edges. Only one bifacially worked point had a concave edge (Gruhn 1971: 141, 142). The body form "varied from lanceolate among the longer specimens to triangular among the smaller" (Gruhn 1971: 141). Reeves (1983b: 55) also recognized a lanceolate form in the Kenney site point collection with varying degrees of convexity along the edge. These dominated the collection, which also had another form with straight body edges which he termed "Besant Trianguloid" (Reeves 1983b: 63).

The dominant transverse or cross-section shape in both of the Melhagen site collections is biconvex. The convex-triangular shape is second most common overall. In the longitudinal section shape category, plano-convex points are only marginally dominant over biplano shapes in the Phenix collection and asymmetrically biconvex shapes in the Ramsay collection. Overall, these latter shapes are each found in 18% of the collection while 30% consists of plano-convex points.

Of the site reports examined, none discussed the longitudinal section shape, but at least one does refer to the cross-section shape. Reeves (1983b: 55) noted that the Kenney site points are planoconvex to biconvex, and that the lanceolate point bases are "lensatic when the base is viewed in cross-section, [while] one or both faces may be concave as a function of the basal thinning techniques."

Left and right shoulder shapes were looked at separately in the Melhagen site collections to see if any substantial difference exists between sides. In cases where the shoulder was broken off, "No shoulder" was indicated in the data matrix. In both collections, the most common left shoulder shape is obtuse-angular, while rounded shoulders are of secondary frequency. The same pattern holds for the right shoulder shapes. There is little difference between the Phenix and Ramsay collections in the distribution of shoulder shape attribute percentages. It does seem to be fairly common for the shoulder shape on one side of a point to differ from that on the other side.

Gruhn (1971) noted that both the bifacially and unifacially worked Muhlbach points have sloping and rounded shoulders. These would seem to differ slightly from the Kenney site points, which Reeves (1983b: 55) described as having shoulders with a "sharp to rounded obtuse angle; rarely approximates acute angles."

The category of notch orientation in the Melhagen points should be discussed here in some detail, as the chart may not be entirely clear. In each case, it was noted whether the point was side or corner-notched. Points were considered as corner-notched if enough of the basal corner had been removed to reduce the width of the base to less than that of the shoulder. Some points are side-notched on one side and corner-notched on the other. It was also noticed that some notches tend to skew towards the proximal end of the point while others are skewed towards the distal end. This terminology could cause some confusion, so a mathematical model will be given as an example. If one imagines a normal bell curve on a graph, a line drawn down (or perpendicular) from the highest point on the graph will bisect the curve. Both halves of the curve will be equal. If the distribution on the graph is unequal, a longer "tail" will appear on one side of the perpendicular line. The graph is said to be "skewed" towards that particular direction (Shennan 1988: 34-35).

Similarly, if an imaginary line is drawn outwards from the deepest part of a projectile point notch, and both sides of the notch are equal, then the notch is said to be "symmetric." If however, a longer "tail" appears in the notch towards the proximal (base) or distal (tip) end of the point, the notch is said to be "skewed" in that direction. These tendencies may reflect the individual motor habits of the flint knapper.

One problem with this category is that some notches are only slightly skewed in one direction. Naturally we would like to distinguish these from ones that are strongly skewed, so there is a danger that the differentiation is inconsistent. Nevertheless, the likelihood of this sort of error has been lessened (not eliminated) by the fact that one person conducted both the metric and non-metric study with an effort to remain consistent.

In the Phenix collection, the left notches are side-notched and symmetric in the same amount (38%) that they are side-notched and proximally skewed. In the Ramsay collection, 35% of the points are side-notched and symmetric on the left side, while only 24% are corner-notched and proximally skewed. Only 18% of the Ramsay points are side-notched and proximally skewed on the left.

The right notches in the Phenix collection are side notched and proximally skewed 42% of the time, and 33% are side-notched and symmetric. In the Ramsay collection, 35% are corner-notched and proximally skewed and 29% are side-notched and symmetric. Overall, the first two of these descriptives dominate the right notch orientation.

If the data from the left and right sides is combined, it is apparent that notch orientation in this collection is usually either side-notched and symmetric or side-notched and proximally skewed, since both occur in fairly equal frequencies (34%). In one case, the point was notched twice on the right side (#10875) in an attempt to rework it. Notch orientation was not always consistent on both sides of the point. In several cases, points were corner-notched on one side and side-notched on the other. The direction of skewness also varied between sides of the same point. It is not known if this was simply a product of the individual manufacturer's motor habits, or if it was a functional design.

Since none of the other authors have looked at notch orientation and skewness with this particular technique, comparisons are difficult to make. This is compounded by the different criteria that different analysts use to distinguish corner-notching from side-notching. For instance, Gruhn described only two of the Muhlbach bifacially worked points as side-notched, and the remainder as displaying "corner-notching or corner removal" (Gruhn 1971: 142). It is the opinion of this author that many more of the Muhlbach points are side- notched. Many of the "corner-notched" points are actually notched more from the side, but the orientation is often proximally skewed. This gives these points a corner-notched appearance without significantly reducing the width of the base. Reeves (1983b: 55) has also noted this trend, as he has described the Kenney site materials as "side-notched to corner-notched, depending on the width of the base in relation to shoulder width."

In both collections notch shapes are dominantly round on both the left and right sides by 72%. A few points have notches that are squared or angular to some degree, but these comprised only a minor percentage of the assemblage. Besant points are generally well-known and even partially classified on the basis of their rounded and shallow notches (see Frison 1971: 80). Thus, these points are consistent with that pattern.

Notch modification is also relatively consistent between the left and right notches and between both collections. The preferred modification is crushing (30%), as well as crushing and dulling (23%). Some of these modifications may develop as a result of rubbing against the atlatl foreshaft haft and bonding material. Again, different modifications are sometimes observed between the left and right notches of the same point. Frison (1971: 80, 82) noted that the grinding of the Ruby site point bases and notches may have been done to provide "optimum strength in bonding the shaft and point."

Basal edge shapes are relatively consistent between sides and collections. In the Ramsay collection, the left basal edge shape is dominantly rounded (41%). This differs from the overall pattern, in which the dominant basal edge shape is more expanding (41%). At 26%, rounded basal edge shapes rate second in overall frequency. The difference between the Ramsay collection and the overall totals is not believed to be significant, and can most likely be explained by the difference in the sizes of the two collections. The basal edge shape patterns can likely be related to the tendency for the notches to be skewed towards the base. In some cases, the skewness and basal edge shape give the point a corner-notched appearance.

The shape of the base itself is quite variable throughout the Melhagen site collection. As is the case with many Besant collections, there seems to be little preference for any particular base shape. Straight bases do tend to slightly dominate the total Melhagen site collection, with a frequency of 37%. The remaining categories have been broken down into more specific degrees of description, such as "concave" and "slightly concave." If we combine the "slightly" categories with their counterparts, we see the sample is divided almost evenly between them. For instance, if the "slightly concave" category is added to the "concave" category, then 28% of the collection has a base that is concave to some degree. If the "slightly convex," "slightly convex/tabbed" and "convex" categories are combined, then it is seen that 32% of the collection has bases that are convex to some degree.

This pattern is consistent with that seen at other Besant and Sonota sites, in that convex and/or straight bases tend to marginally dominate the concave-based points. Obviously it would be of little use to differentiate point types on the basis of base shape attributes alone.

A variety of basal modifications were distinguished in the Melhagen site point collection. The analyst admitted some difficulty here, since many points from the Phenix collection had been extensively handled around the base. Usually more than one modification technique was seen on the same base. Several point bases had been retouched by flaking, and/or thinned to some degree. Dulling and crushing are also very common, and may actually be a by-product of light basal grinding. Although only one heavily ground base was observed by the analyst, it is the opinion of the author that grinding is probably more common.

Basal grinding is apparently more prevalent in other Besant collections. It was seen in the Ruby site materials, and was very dominant in the Muhlbach collection. Reeves examined this collection in some detail, and noted that "basal grinding is extremely heavy, with the bases having been ground down to a flat plane as much as 1 mm in width" (Reeves 1983b: 57). In both the Long Creek and Mortlach site collections, point bases had been thinned by the removal of flakes from the base towards the tip, and no doubt was responsible to some degree for the concavity of the base (Wetlauffer 1955; Wetlauffer and Mayer-Oakes 1960). Dulling was seen in six of the seven Ross Glenn site point bases (Quigg 1986: 99).

If anything distinguishes the Phenix and Ramsay collections, it is the difference in the degree of patination between the two collections. It is not a feature that has been noted in other Besant site collections. Patination is a chemical change that occurs on the surface of Knife River flint and other chalcedonies. Patination tends to change the surface colour of KRF from its usual dark brown to a milky white. In cases where patination is extremely intense, the process changes the colour to a solid whitish yellow. It largely occurs as a result of any one or a combination of several factors. These include exposure of the artifact to chemical precipitates in the soil, and exposure to weathering from the sun, wind and temperature fluctuations. Time plays some role in the degree of patination, but it is not possible to accurately date sites by measuring surface patination on artifacts (VanNest 1985: 325-339).

As has been mentioned before, the Phenix collection is entirely unpatinated. In the Ramsay collection, only three of the nine KRF points are unpatinated. Furthermore, 65% of the Ramsay point collection has some degree of calcium carbonate build-up, while the Phenix collection is free from it. Mr. Phenix has told the author that calcium carbonate crusts were not observed on any of his points, and were not removed from any points or other artifacts. Clearly the 1986-87 excavations were concentrated in an area of the site that were subjected to different environmental conditions.

All of the Melhagen site points display primary retouch on at least one surface. Most points (75%) have primary retouch on both surfaces. The Kenney site points also display primary retouch on both surfaces, except in those cases where the points are unmodified on the dorsal surface (Reeves 1983b: 55). The Ross Glenn points exhibit the presence of primary retouch in most cases on both the dorsal and ventral surfaces (Quigg 1986: 176-177).

Secondary retouch occurs on both surfaces along the edges in 93% of the entire Melhagen site collection. It is absent in only one point from the Phenix collection (#10865). Reeves (1983b: 55) noted that in the Kenney site materials, secondary retouch is found only along the lateral edges. Quigg (1986: 176-177) found that secondary retouch occurred much less than primary retouch in the Ross Glenn points, and was often marginal.

Although evidence of use-wear has been recorded in Table 5.2, it is felt that this category must be approached with some caution. Points made from KRF exhibit use-wear evidence quite clearly since KRF has a cryptocrystalline structure. Use-wear on KRF and chalcedonic materials can be so evident that it can easily be seen by the naked eye. Use-wear evidence is not so obvious, however, on tools made from materials that have a more granular or crystalline structure. This fact has no doubt created some degree of bias in the use-wear analysis. Furthermore, some of the use-wear seen on the tools may simply be the result of handling by their original owners or makers.

Another very important factor to consider is the storage and handling conditions of each of the artifact collections. The Phenix collection has been stored loosely in a glass case for some 20 years. The points have rattled against each other, and have been extensively handled since they were excavated. The result is that these points do display considerable post-excavation chipping and nibbling, which is generally more randomly located across the point than is actual use-wear. Polishing along the edges caused by extensive handling is not so readily distinguished from use-wear.

Environmental conditions that stone tools have been subjected to for nearly two thousand years could also bias the analysis. Many of these points were subjected to sandblasting, temperature extremes, frost heave and other pedoturbationary processes. All of these processes may have polished or chipped stone surfaces enough to create some confusion with actual use-wear. Therefore, the following discussion of use-wear should be carefully applied.

It appears to be present on both the dorsal and ventral surface edges of most of the collection, in the form of polishing and minute chipping. It is often found on both edges of the points and sometimes the base. Basal use-wear is difficult to interpret. It is possible that some loose points were picked up and the bases were used as cutting edges or as scrapers, but it is more likely that the polishing seen here is a result of haft preparation, or the point base rubbing within the foreshaft hafting area. Impact scars may be seen in a few cases, and in other incomplete points, the tip has been broken off entirely. Several point bases that were not included in this analysis show that points were often broken below the neck, either on impact, or were being used as a spear or knife and were twisted too hard. This is a pattern that was also noted by Frison (1971: 82), who observed that 59% of the recovered Ruby site points were "broken either across the notches or from one notch diagonally to the base, suggesting rough usage which could indicate the use of thrusting spears with long shafts as well as dart shafts."

Comparative data on use-wear is not present in most of the available literature, largely because use-wear studies were not commonly done when many of these Besant and Sonota site were excavated. Quigg (1986: 176-177) has noted the occurrence of a small amount of use-wear on projectile points in his Ross Glenn site data table, but does not discuss the significance of this feature at all. Gregg (1987: 278) observed that five of the 12 points at the Naze site display impact fractures, and four points have rounded and smoothed blade edges which he attributes to their use as light duty cutting tools. He noted that similar features may be seen in the Anderson Tipi Ring site points (32ML111) in central North Dakota (cf. Deaver 1985: 73).

Reworking of the projectile points would have taken place if the owner decided to modify the point into a different tool, or to resharpen a dulled edge or tip. One broken point not included here (#5645) has been reworked into a graver tool. In another case (#10868), reworking and resharpening resulted in the development of concave edges along the blade. In the combined Ramsay and Phenix collections, reworking is present 51% of the time on the dorsal surface and 33% of the time on the ventral surface. It is clear, however, that constant resharpening of points and other cutting tools occurred in the entire area. Tiny microflakes indicative of resharpening and other tool manufacturing activities are well-distributed over most of the excavated site, and all lithic materials found at the site are represented within their numbers.

Initially the author had assumed that reworking of the edges would account for much of the asymmetry in point shape. This certainly seems to be the case with the Ruby site points. Frison (1971: 80) noted that at least one point was formed from the distal portion of a broken point, simply by renotching the blade and using the broken transverse break as the new base.

Furthermore,

> if the break was not at right angles to the longitudinal axis of the point, the notches were skewed as a result, which was compensated for by removing a few flakes on one blade edge near the point. This resulted in a significant number of projectile points asymmetrical in outline form. Projectile points broken distally were often repointed, and this was done in such a manner that a sharp tip was made changing the configuration of the blade edges so that they were noticeably concave near the point (Fig. 4*c, h, i, k*). Others have blade edges completely reworked (Fig. 4*p, q*). (Frison 1971: 80)

However, in the case of the Melhagen collection, reworking and point asymmetry are apparently statistically unrelated. This was shown by cross-correlations that demonstrated that asymmetry occurs in points that are not reworked, as often as it occurs in points that are reworked. While point reworking should not be ruled out as a direct cause of asymmetry, it seems that asymmetry could often be a result of how a point was broken, and how the flint knapper decided to refashion a working tool. Points that have been resharpened could actually end up very symmetrical in outline, if they have been worked equally on both edges. In other words, reworking can cause a point to be symmetrical as easily as it can create asymmetry.

A few things should be emphasized before proceeding to the next part of the analysis. First, it is apparent that Knife River flint is *not* necessarily found in higher frequencies at Sonota sites than it is in Besant sites. So-called "definitive" Sonota sites such as the Stelzer site may actually have a lower percentage of KRF than many Besant sites. The pattern seems to be that habitation sites which are further removed from the KRF source have less KRF in them. Kill sites, especially pound sites, have a higher occurrence of KRF, as do some other sites located closer to the KRF source. It is possible that people obtained their KRF directly from the source or through trade, and then ventured out into the Plains to engage in communal hunts. Sites which were formed soon after the acquisition of KRF would reflect a higher presence of the material than those which formed after the KRF supply had been depleted.

Overall, the Melhagen site projectile points compare well with other Besant and Sonota sites in terms of their size and morphology. Certainly the range of variation seen in other collections is repeated within this one site. It is felt that much of this variation is a reflection of the alternate functions of the projectile points as knives. It is regrettable that better use-wear information is lacking in site reports, and in this collection. However, many archaeologists working today now try to refrain from over-handling and cleaning artifacts, so perhaps future reports will address this feature. The issue of point reworking is not really resolved in this section, and requires further analysis. In the next section, it will be addressed again, and related to projectile point size, function and material type. These things are most likely at the root of the variation seen in Besant assemblages, but also may help to explain some of the similarities.

c) Principal Component Analysis

Statistical applications to Late Prehistoric projectile point variation have previously been done by Greaves (1982), Fawcett (1980) and Reher and Frison (1980). As was previously discussed, these attempts have largely failed to include functionally related attributes. In this study, an attempt will be made to see if two separate occupations are statistically reflected as distinct groups within the Melhagen projectile point assemblage. This study will employ a factor analytic method known as principal component analysis (PCA) for reasons that were noted earlier (pages 82 to 84).

Shennan (1988: 244-270) has provided a comprehensive discussion and archaeological application of this technique.

The PCA program is based on a correlation matrix between the 15 quantitative variables. Standardization of the variables is implicit in such an analysis and means that they are given equal weight irrespective of their absolute values.

The PCA program first extracted 15 components and displayed a factor matrix. Of these 15 components, the first five were initially considered, the first three components extracted having eigenvalues which were $\geq$ 1, and the next two components had eigenvalues that were close enough to one to warrant further consideration. The factor matrix, or matrix of attribute loadings (Table 5.5) displays the correlation of each variable (measured attribute) with each component extracted. Those variables with high absolute values therefore have high correlations with a particular component. This table clearly shows that different groups of attributes are strongly correlated with different components. The communality of each variable is also shown in this table. It is a measure of the proportion of variance for the attribute accounted for by the informative components. It will be discussed in more detail later.

The eigenvalues shown in this table for each component are obtained by summing the squares of the variable correlations within each component. The eigenvalue therefore represents the sum of the variance of all the variables and thus the total variance accounted for by the component. The percentage of variance accounted for represents the proportion of variance that the component accounts for in the whole data set. To obtain this, the eigenvalue for the component is divided by the number of attributes (15 in this case), and this result is then multiplied by 100.

Thus, Component 1 accounts for almost half (48.1%) of the variance in the analysis. The first four components together account for a cumulative percentage of 80.7% of the variance. The scores for each artifact, or sample, were also calculated on each component (Table 5.6). These values were used to plot the components against each other (see Figures 5.3 to 5.10). These plots were especially useful when the coded qualitative variables were overlaid on the plots. Patterns that are seen in the plots will be discussed later in the analysis.

Components

<u>Component 1:</u> The large proportion of variance accounted for by this component is one of its most important features. Apart from that, the most striking thing is that all of the variable loadings within it are positive. This means that it is a general component related to the overall size of the artifacts. The highest values here which do not score higher on another component, in order from highest to lowest, are maximum width, shoulder width, weight, left notch height, right notch height, left notch depth, left basal height, right notch depth and right basal height. With the exception of the weight variable, all of these relate directly to the size of the shoulder width and notch dimensions. One important thing to note is that the variables which had the most means inserted have some of the lowest correlations. This was to be expected, since the insertion of the means has caused them to show relatively low variance on this general size component.

It is also of interest to note that variables from the left side of the artifacts score heavier than those of the right side. This would seem to indicate a degree of asymmetry in the artifacts, and underscores the need to separate left and right measurements. In summary, Component 1 relates to the size of the artifacts and especially the size of the shoulder and notch region in the assemblage variation.

<u>Component 2:</u> The highest positive correlations in the second component that do not score higher elsewhere are with right

body length, left body length and maximum length. These are the three length measurements which have the most substituted means. The highest negative correlations include right basal height, right notch depth, left basal height and right notch height. The high negative correlations on variables from the right side of the artifacts again suggests asymmetry in the projectile points. The second component therefore contrasts body length with basal height and is related to the relative slenderness and notch size of the points.

Component 3: The highest positive loadings on Component 3 are the neck width and the maximum base width. The highest negative loading is right notch height. These values would indicate that Component 3 is a measure of the shape based on the width of the basal or proximal parts of the artifacts. It is clear that whereas Component 1 represents the absolute size of the points, Components 2 and 3 define their shape.

Component 4: Component 4 does not have any variables with loadings >0.5. The highest scores contrast both of the basal heights and maximum thickness with the left and right notch depths. Despite these low loadings and low eigenvalue, these relationships are still meaningful. For instance, thicker points may require more grinding and thinning in the basal area, and more work on the notches in order to facilitate hafting. It is not unreasonable to assert that this component could also be related to the high degree of grinding and thinning that are often noted in Besant point collections.

Component 5: This component was dominated only by the thickness variable. No other variables are significant here. It therefore acheived no simplification and since the eigenvalue of

Component 5 is also significantly <1, it is more useful to concentrate on the first four components and drop the fifth and remaining ones from further consideration.

Communalities

As mentioned before, the communality is a measure of the proportion of variance of each attribute accounted for by the the analysis. It is calculated from the sum of the squared values across the components interpreted from the analysis (four in this case). A variable with a small communality value plays only a small role in the analysis. Such an attribute varies so that it has little in common with the other attributes (Shennan 1988: 272). In this analysis, the variable which accounts for the least variance in the analysis is maximum thickness. The left body length variables have the highest proportion of variance accounted for despite the fact that they have the highest number of communalities and hence average substitutions.

Ordinations

The second step carried out by the PCA involved the calculation of each artifact's score on each component. These scores are seen in Table 5.6. These scores were then plotted against each other in ordinations, revealing overall patterns within the collection. Component 1 was plotted against the three other components. Next, Components 2 and 3 were plotted against each other.

It is fairly simple to read these plots. For example, figures in which Component 1 is plotted against Component 2 (Figures 5.4 to 5.7) show the relationship between the absolute projectile point size, and relative body length and basal height. Other plots not included here related Component 1 (absolute size) against Component 3 (basal and neck widths), or against Component 4 (thickness). The symbols represent categories of descriptive terms in the qualitative data. Thus patterns inherent in the qualitative data relative to quantitative trends may be detected.

It became clear from the plots (including those not illustrated here) that there is no definite separation between projectile points based on culture groups alone. Even in plots which relate Components 1 and 2 (Figures 5.4 to 5.7), it is apparent that two or more cluster groups representing "Sonota" versus "Besant" are not distinguished. The plots of Component 1 vs. Component 2 give the strongest indication of patterning, but most likely relates to the artifacts' function than to cultural origins.

Another important part of this analysis lies in the associations visible when the qualitative data is plotted on the ordinations. Because plots of Component 1 versus Component 2 demonstrate patterning in the position of their points, they will be described in some detail. Plots of Component 2 versus Component 3 will also be examined.

Component 1 vs. Component 2 - General Observations:

The plot or scattergram (Figure 5.4) may be examined by looking at the relationships of points in each quadrant of the plot. Points in the upper left quadrant are small in absolute size, with relatively large body lengths and reduced basal or proximal dimensions. Points in the lower left quadrant are also small in absolute size, but have relatively small body lengths and larger basal heights. The upper right quadrant contains points which are large overall, with relatively large body lengths and small basal heights. Those found in the lower right quadrant are also large overall in absolute size, but have a relatively short body length and large basal height.

Many of the points seem to cluster in a central ellipse that runs from the upper left to the lower right quadrants. This central ellipse indicates that as absolute size of the points increase, other proportions concerning relative size in the basal area also increase, while relative length decreases. This large group of points represents the range in size of atlatl heads.

There also appears to be a scattered group of points in the upper right quadrant and two more strongly associated group of points in the lower left quadrant. The points in the upper right quadrant cluster are most likely knives, or possibly spear tips. Such artifacts would possibly be larger for added strength and a longer cutting edge, and would therefore be longer than an atlatl or arrow tip. If these points were used as spear tips, one would expect to find impact scars on the tips, or several with broken tips from thrusting actions. It can be deduced from Figure 5.4 that several of the artifacts with missing length values would have been found in this category if they had been complete. In other words, there are artifacts in which the average (40.9 mm) value substituted for the missing maximum length values, may actually be significantly less than the original or actual value of the complete point. In these cases, the length, even with the tip broken off, is greater than the substituted average. The inclusion of these points in the analysis creates a few interpretive problems which will be examined in more detail later on. For now, it can be asserted that the knife and spear tips may be under-represented in the upper right quadrant and over-represented elsewhere. Also, if they had been used as knives, they would display use-wear evidence (polishing, nibbling, and dulling of the edges), and may have been resharpened. This will also be examined later on.

The points lying away from the ellipse in the lower left quadrant may actually represent points that have been extensively reworked or modified from broken points., or points that were perhaps simply smaller to begin with. Until we look at other plots to discover the influence of their relative widths, it is too early to classify them into a tool category.

Two points are located in the extreme upper left quadrant away from the ellipse. Their position indicates that they are much smaller in absolute size than the others, and have a much longer relative body length and a smaller basal height. In both of these cases, the maximum length value was missing, since the extreme tips had been broken off. The actual original lengths were in fact much less than the substituted value (40.9 mm), and so their positioning on the plot should be more extreme on the relative length scale. They are still smaller in absolute size than the rest of the central cluster and could represent Samantha points (arrow points), or simply a smaller atlatl point.

The ordination of the points based on Components 1 and 2 should now be discussed in terms of their qualitative variables.

Collection: It was suggested earlier that the Ramsay points were generally smaller and squatter in size than the Phenix points. In this plot (Figure 5.4), the open circle symbol corresponds to the Phenix collection and the solid square symbol denotes the Ramsay collection. In all of the remaining plots, a solid symbol will continue to represent the Ramsay points, while hollow symbols will represent the Phenix points.

It is clear from the plot in Figure 5.4 that most of the points which are larger in the basal dimensions (lower half of the plot) are from the Phenix collection. Both Phenix and Ramsay points are well mixed in the left side. This would indicate that they are both represented in the small absolute size range. Perhaps most importantly, nine of the thirteen Ramsay points are within the upper left quadrant and represent eight of the 19 points in that half of the ellipse. This shows that the Ramsay points are predominantly small, with a relatively long body length and short basal height. Furthermore, most of the Ramsay points tend to cluster within the central ellipse. One of the outlying Ramsay points in the upper right quadrant is within the group of knife or spear points, and another outlying point is located just barely within the lower right quadrant. The Phenix points appear to be fairly evenly distributed throughout all four quadrants, thus displaying a very wide range of variation. In summary, the Phenix collection is distributed over the ordination whereas the Ramsay collection predominates in the upper left quadrant. They represent small points with relatively long bodies and short bases. They are not squat as previously suggested, unless this term refers to absolute size alone.

Raw Material Type: It was postulated that the Phenix collection had a higher percentage of Knife River flint (KRF). This is true, as Table 5.4 clearly demonstrates. The Phenix point collection is comprised of 78% KRF, while the Ramsay collection has 53% KRF. If both are combined, the entire point collection consists of 70% KRF.

From this plot (Figure 5.5) we can try to determine if projectile point sizes are linked to their raw materials. In other words, does the distribution of locally available materials differ from that of the so-called "exotic" or imported raw material (KRF)?

The most significant thing in this ordination is that the upper right quadrant consists entirely of KRF and brown chalcedonies. These chalcedonies may also be imported from distant locations, but this would be difficult to determine without thin sections from the artifacts and comparisons with raw material sources. On the other hand, other locally-available chalcedonic-like materials such as silicified peat and silicified wood can usually be distinguished from KRF on the basis of their physical properties and appearance. As noted previously, the tools in this quadrant consist most probably of knives and spear points.

The distribution pattern in the upper left quadrant of Figure 5.5 indicates that KRF points are clustered within the ellipse, except for one. The small point made of jasper is proportionately longer, and slightly smaller in basal proportions than the smaller outlying KRF point. Four of the five Swan River chert (SRC) points are also found in this section of the ellipse, and three of these are from the Ramsay collection. The most significant thing about the upper left quadrant is that it displays the heaviest concentration of non-KRF points (eight of fifteen). Thus many of the points made from locally available materials tend to be smaller in absolute size with an average to long relative body length and smaller basal height. This suggests that the properties of these raw materials must therefore play a significant role in how they are formed into tools.

In the lower left quadrant, KRF points tend to dominate much like they do in the remaining quadrants. Three types of chert are found in this quadrant, including an undetermined chert, black pebble chert and Swan River chert.

In the lower right quadrant one chert and one fused shale point are located fairly well within the central ellipse. However, the problem created by substituted values presents itself in this quadrant. It appears from the plot that points that are short relative to absolute size and which have a larger basal height tend to be made primarily from KRF. Five of these points (Catalogue Numbers 10865, 10867, 10882, 10883 and 10889) have greater broken lengths than the substituted average length value. One other such point is located barely within the upper left quadrant (#10874). The bulk of these might have been located within the upper half of the plot if the original lengths had not been substituted by the average value. Since there is no reliable way of estimating their original unbroken length, one could easily argue that they should have been dropped from the analysis. If this had been done, however, the result would have been an underrepresentation of this point type. We would have also lost information regarding the importance of their relative basal and width dimensions in the analysis. For these reasons these points were retained in the analysis.

Overall, KRF is distributed across the plot area relatively evenly through all sizes and shapes of projectile points. Local (or non-KRF) materials are generally located where points have a smaller absolute size, and tend to be found within the central ellipse along with several KRF points. Larger points consist almost entirely of KRF, not manufactured from locally available materials.

Patination: In this plot, (Figure 5.6) it is clear that all six of the patinated points are from the Ramsay collection. Forty one percent of the Ramsay collection is patinated, comprising 12% of the entire point collection (Table 5.4). This is strong evidence that different environmental conditions existed across the site from west to east, since chemical precipitates in the soil are believed to cause patination of KRF and chalcedonies.

With the exception of the large knife from the Ramsay collection (#2973), and the smaller point in the bottom left quadrant, all the patinated points tend to cluster in size along the ellipse, with a tendency to be concentrated among those smaller points which have a relatively longer body length.

Reworking: It has been suggested earlier in this chapter that projectile points may also have been used as knives and processing tools. If they were used for these purposes, they would become dull and require resharpening. The most obvious thing to look for then is evidence of use-wear, reworking and resharpening.

As discussed earlier, the points were examined for evidence of use-wear along the edges (polishing, dulling, nibbling, etc.). Because so many factors may have altered, obscured or biased this evidence, caution is again urged against applying the information uncritically to the sample analysis. For these reasons, the category of use-wear has not been plotted on the ordination. Instead, evidence of reworking has been the focus, and it is suggested that it provides the most reliable indication of multiple functions of projectile points in this study.

The evidence of reworking and resharpening was examined on both the dorsal and ventral surfaces of each artifact. Reworked points had clearly been reshaped as a function of breakage or remodification (Binford 1963: 207). Although it has been tabulated separately, evidence from both surfaces has been combined for this plot. An examination of Table 5.4 shows that there is a difference in the amount of reworking between the Ramsay and Phenix collections. The points in the Phenix collection have dorsal reworking at a rate of 65%. The Ramsay artifacts are reworked on the dorsal side 18% of the time. When both collections are examined together, 51% of them are dorsally reworked. The difference in ventral reworking between the collections is even greater: 0% in the Ramsay collection, and 79% in the Phenix collection. When both collections are combined, 33% display presence of reworking on the ventral side. When the data from both surfaces is combined, 56% of the Phenix collection and 9% of the Ramsay collection display a presence of reworking. Overall, 46% of the points show reworking on both the dorsal and ventral surfaces.

Figure 5.7 shows that absence and presence of reworking is distributed over the entire plot. This would indicate that several of the points were reused, most likely for more tasks than as atlatl tips, and were subsequently resharpened or modified. Thus there does not appear to be any direct link between reworking and size.

There is some patterning when the raw material type is compared with size and reworking. If the upper half of the plot is examined, it may be seen that the points which are long relative to absolute size have 17 KRF and 10 non-KRF points. Nine of the 17 KRF point (53%) have been reworked, while only three of the 10 non-KRF points (30%) have been reworked. In the bottom half of the plot, the points which are short relative to absolute size consist of 21 KRF and five non-KRF points. Eleven of the KRF points (48%) and four of the five non-KRF points (80%) are reworked. Reworking is therefore fairly evenly distributed among the KRF points regardless of the relationship of relative length to absolute size.

In contrast, the shorter non-KRF points seem to show a higher presence of reworking than either the long or short KRF points, and more than the longer non-KRF points. This was not expected since KRF is imported and might be considered a preferred material. It would therefore be expected to show a much higher degree of reworking and modification, as a reflection of some effort to get as much utilization from a single tool as possible.

On the other hand, the non-KRF points may have been reworked to a higher degree in an effort to conserve the KRF points. Intensive butchering results in a high rate of tool breakage, especially with thin, delicate KRF tools. If this was the case, then what we are seeing may actually reflect a preference of KRF as a raw material used in the production of *hunting* weapons, while the locally available (and more expendable) raw materials were used for intensive *butchering and processing activities* . Thus Phenix may have concentrated his excavations in one of the primary kill areas, while the Ramsay excavations were located in an area which reflects a greater intensitity of processing activities. This could also explain why so many of the habitation sites in the Northern Plains have lower amounts of KRF, especially when they are located further away from the KRF sources in North Dakota.

An alternate, but related explanation is that the Phenix excavations are located in the initial kill site area, and that this event occurred at a time when the KRF supply was abundant. Areas with lesser amounts of KRF points could reflect other kill events which occurred when the availability of KRF was considerably less, and locally available materials were used fairly intensively. These times could have occurred during the late winter and early spring, when groups settled in the sheltered parts of this area for the winter, and utilized the frozen stock of meat from the kill. This will be discussed later in this thesis.

The apparent lack of effort on the part of the hunters to recover KRF from bison carcasses may indicate that the people who used these areas of the site had relatively easy access to KRF sources, either through trade contacts or through their own efforts of importation. That KRF was a preferred material is undoubtedly shown through its high representation at the site. It must also be cautioned that we have no way of knowing how many of the original number of points were retrieved. It seems however, that the people who exploited the bison here had little reason to anticipate a shortage of KRF.

Component 2 vs. Component 3 - General Observations: These two components have been plotted against each other to give a general idea of the relationship of relative length to relative width, or the *shape* of the artifacts. The plots are found in Figures 5.8 to

5.10. This comparison is necessary if we are to see if two point groups can be separated on the basis of these factors. A glance at Figure 5.8 shows clearly that no such groups can be distinguished on the basis of shape alone. Comparisons with general patterns of point group associations derived from the Component 1 vs. Component 2 (C1-C2) plots should also be made. Note that the object here is not to directly compare the quadrants of one series of plots with its corresponding quadrant in the other series. Rather, the object is to see if point groupings and relationships are consistent between both plot series, and to interpret these associations.

The X-axis (Component 2) in this plot represents a measurement of relative length, contrasting with basal height and notch depth, while the Y-axis (Component 3) indicates relative width contrasting with notch height and right notch depth. The upper left quadrant consists of points which have a relatively greater neck and base width (P.C. 3), a shorter body length and larger basal height (P.C. 2). Points found in the lower left quadrant have a relatively narrower width, shorter length and larger basal proportions. In the upper right quadrant, points have a relatively greater width, longer length, and smaller basal proportions. Those in the lower right quadrant have a relatively narrower width, longer length and smaller basal proportions.

The outlying points in the Component 1 vs. Component 2 plots were of special interest. The location of these same artifacts on the Component 2 vs. Component 3 (C2-C3) plots is also of interest, as this series of plots brings into account the influence of relative width. For example, it was suggested that the group of outlying points in the upper right quadrant of the C1-C2 plots are most likely knives or spear tips. This was based on the fact that these points are relatively long and have a large absolute size. Most of these same points (five of the seven) are found in the upper right quadrant of the C2-C3 plot, while the remaining two are found in the lower right quadrant. These points are therefore consistently long, tend to be wide in the neck and shoulder region and have smaller basal proportions. These characteristics would seem to support the suggestion on the basis of their size alone, that these points were not designed to function as atlatl tips. They could have been used at close range for thrusting. The long cutting edge would have made them suitable also for the cutting of hides and muscle tissues.

The two points which were isolated in the C1-C2 plots in the lower right quadrant (#10892 and #10888) are again isolated in this C2-C3 plots at the extreme left. Their positioning here indicates that they have the shortest relative length of all the points and that they are also relatively wide with larger basal heights. Points found isolated in the lower left quadrant of the C1-C2 plots are found distributed together throughout both the upper and lower left quadrants of the C2-C3 series of plots.

The two points found in the extreme upper left quadrant of the Component 1 vs. Component 2 plots (#3021 and #3708) are found in the lower right and upper right quadrants of the C2-C3 plots respectively. These points have an extremely long relative length in comparison to absolute size (see the C1-C2 plots), but do not appear to be so far out of the normal range of variation when their relative length is compared to relative width. Thus the effect of the substitution of the average length value (40.9 mm) does not seem to have had as much of an effect in this plot series as it did in the last.

Collection: This plot (Figure 5.8) clearly shows two major things. First, it is clear that the points from the Phenix collection fall into all categories of point shapes. Second, points from the Ramsay collection are conspicuously absent from the upper left quadrant, and only three are found in the lower left quadrant. They therefore dominate on the right side of the plot. Thus, none of the Ramsay points could be classified as short and broad in shape, and only three are short and narrow. The heaviest concentration of Ramsay points (seven of the 13) is found in the upper right quadrant, which would indicate that most are relatively long and wide, with wide necks and bases and small basal heights.

Raw Material Type: This plot (Figure 5.9) allows us to see if material type can be linked to projectile point shapes. Most of the non-KRF points from the entire collection are in the upper two quadrants and are hence among the widest points. The exceptions to this in the lower left quadrant are artifacts #10875 (fused shale) and #10858 (Swan River chert - SRC). In the lower right quadrant, the exceptions are artifacts #10878 (chalcedony) and #10855 (SRC). All four of these points are from the Phenix collection, and three of them are reworked.

It appears that KRF points are well-distributed in all quadrants, and hence seem to be found in all possible size and shape ranges. The frequency in which they are found is relatively equal (between 80% and 83%) in all quadrants except the upper right quadrant, in which only 47% of the points are made from KRF. Thus most of the long and wide points are made from locally available materials.

Swan River chert is found in all but the upper left quadrant, and other types of chert are found in both of the upper quadrants. Chalcedony is found in both of the right quadrants. The one jasper point is in the upper right quadrant.

It can be said with some certainty that the raw material of a projectile point is related to the shape and size of the tool to some degree. KRF is found in all shape categories, while non-KRF points are not found as often in projectile points that are narrower with larger notch height.

<u>Reworking:</u> The C1-C2 plot series (Figure 5.7) which dealt with reworking showed that KRF shows a relatively equal presence of reworking, regardless of the size of the artifact. It also showed that of the non-KRF points, shorter points have a higher presence of reworking than all of the KRF points, and more than the longer non-KRF points. The C2-C3 plot (Figure 5.10) will help us to examine the relationship between the presence of reworking, and the artifact shape.

Artifacts in the upper left, lower left and lower right quadrants have a relatively equal presence of reworking (between 60% and 69%). The upper right quadrant artifacts are quite different, in that they only demonstrate a 36% presence of reworking. This quadrant is also significant because of its relatively low frequency of KRF points.

The relationship between artifact shape, raw materials and the presence of reworking may also be studied at this time. In the upper left quadrant, 9 of the 13 (69%) of the KRF and two of the three (67%) of the non-KRF points are reworked. In the lower left quadrant, four of the eight (50%) of the KRF and both of the two (100%) of the non-KRF points are reworked. In the upper right quadrant, two of the seven (29%) of the KRF and two of the eight (25%) of the non-KRF points are reworked. In the lower right quadrant, seven of the 10 (70%) of the KRF and one of the two (50%) of the non-KRF points are reworked. Thus the highest amount of reworking of KRF points occurs in those which are either long and narrow, or short and wide. The highest amount of reworking in the non-KRF points occurs in those which are short and narrow. The lowest amount of reworking occurs in both the KRF and non-KRF materials in those points which are long and wide with short notch heights.

To summarize further, of the longer points, 9 of the 17 KRF (53%) and three of the 10 (30%) non-KRF points are reworked, with 44% of the relatively long points reworked overall. Of the relatively shorter points, reworking is present in 13 of the 21 KRF points (62%) and in four of the five (80%) of the non-KRF points, so that 65% of them are reworked. The relationship between relative point length and reworking is clearer in this series of plots, than it was in the C1-C2 plots. In other words, reworking seems to be more frequently absent in the longer points.

Width may also be examined in this way. Eleven of the 20 KRF (55%) relatively wide points and four of the 11 non-KRF (36%) relatively wide points are reworked. Reworking is present in 11 of the 18 (61%) relatively narrow KRF points and in two of the three

(66%) of the relatively narrow non-KRF points. Thus reworking seems to occur in approximately the same frequency in all but the wide non-KRF points, where it occurs in a reduced amount.

5.2.4) Analysis Summary

This chapter has assessed the quantitative and qualitative attributes of the Melhagen site projectile point assemblage. Comparisons with projectile point data from other published Besant and Sonota sites has demonstrated that the Melhagen collection embraces the very wide range of variation that seems to characterize Besant point assemblages.

The Principal Components Analysis has shown that no distinct groups of points can be statistically determined with this sample on the basis of cultural differences alone. Rather, the Melhagen projectile point collection is characterized by a continuous range of variation. The PCA also distinguished between absolute size on one hand, and relative size, or shape on the other. This emphasizes that traditional descriptive terms such as "squat" or "elongate" are meaningless unless they are further qualified with reference to size and shape.

The high correlation of shoulder width with the general component (PC1) and the fact that it is one of the variables least subject to breakage, suggests that this is the most useful estimator of absolute size. Total length is another good indicator of size but this will only be true in assemblages where thickness has low variance and it is, of course, subject to inaccuracy due to breakage.

The Component 1 vs. Component 2 plot series showed that there is a differentiation of point groups that is related more to the artifacts' functions, and not directly to culture. The patterns that were revealed seem to weaken Syms' strictly cultural explanation of Sonota and Besant point typologies, although it is understood that stylistic variation may still be a factor in projectile point variation. It is very possible that regional comparisons may reveal patterns of variation across the Northern Plains which could be linked to cultural distance and local environmental adaptations. At this time, a cultural explanation for the point groups cannot be proven without the comparison of data from several sites. The patterns seen here have also been seen at several sites with Besant components, and may be related to lithic preferences, regional and seasonal access to preferred (KRF) materials, site activities, preferences of certain raw materials for certain tasks, and individual craftsmanship.

It appears that points made from locally available materials are smaller in absolute size. It has been suggested from the analysis that material type is related to the decisions made by the tool manufacturer. Knife River flint is found in all size categories, and especially dominates the largest points, which are knives or spear tips. No direct relationship seems to exist between the presence of reworking and absolute point size, but there seems to be a link between reworking, point size and material type. Reworking is found to be distributed evenly through all KRF points regardless of their absolute size. The smaller non-KRF points seem to demonstrate a higher incidence of reworking. These points may be shorter because of the fact that they are reworked, and/or because they were smaller to begin with.

The Component 2 vs Component 3 analysis showed that of the KRF points, those which are long and narrow, or short and wide are the most highly reworked. Points made from local materials have the highest incidence of reworking in the short and narrow category. Again, this could suggest a preference for locally available materials for heavy butchering tasks, and a preferential use of KRF in hunting tools. It is also possible that the Besant people did not make much of an effort to recover and rework points made from KRF because they had fairly easy access to KRF sources and saw little need to conserve it. More likely, it seems that the KRF point supply was depleted in the course of main kill event at the site, which is located where Phenix conducted his excavations. The author may have excavated in areas that were associated with the processing and subsequent repeated uses of the site when KRF was in lower supplies. It should be emphasized again that these results could either be supported or disclaimed in the course of comparative analysis and studies involving distance-from-source factors.

An important aspect of the statistical analysis is that it has set the groundwork for future researchers. Some important quantitative and qualitative attributes have been identified, and a framework for further study has been formulated. It is by no means an exhaustive study, and several adjustments could be made if it is to be applied any further. First, it would be necessary in the future to collect comparative information in a consistent manner. Quantitative measurements would have to be standardized for all collections. The qualitative data should be collected and summarized in such a way that it can be more readily combined with the metric data in computer analysis. Care should especially be taken by all researchers not to overhandle tools, thereby destroying or obscuring valuable use-wear information. Future researchers may want to consider the inclusion of broken points, and make decisions regarding how to handle missing measurements or information in the statistical analysis. If knife or spear tips can be statisitically differentiated in other collections, it may be desirable to drop these and concentrate on variations within atlatl tips alone. While detailed statistical studies have been done by others (Fawcett 1980; Greaves 1982; Reher and Frison 1980) on collections from younger Late Prehistoric collections, none have dealt with the Besant assemblages in the same detail, or with as many qualitative attributes taken into consideration. Until such attributes are incorporated into these studies, it will be difficult to understand the variation seen in projectile point assemblages.

5.3) Radiocarbon Dates

Samples for radiocarbon dating were independently taken by Phenix and this author. All samples consisted of bison bone materials. It is not known what bone elements were used in the Phenix samples. Bones used in the Ramsay samples are identified in Table 5.7. One of the samples was taken by Phenix in 1971, and the others were sent in at a later date. The samples were analyzed at the Saskatchewan Research Council Radiocarbon Laboratory in Saskatoon.

Three samples of bone taken in 1986 by this author were also sent to the SRC radiocarbon laboratory. The results of the radiocarbon analyses may also be found in Table 5.7.

Figure 5.11 visually demonstrates the clustering of the uncalibrated radiocarbon sample results with both 67% and 95% standard error bars. As a group, these dates (with the 95% standard error bars) span the entire known time period of the Besant phase (2000 B.P. to 1150 B.P.) (Dyck 1983: 113). The most recent standard error range of sample S-2857 (400 RCY at 95% standard error) falls outside of an acceptable Besant date, and thus merits some discussion. The oldest date range for this sample is 1220 RCY (at 95% standard error). It is possible that this is a valid date, and that this particular area of the site represents a later occupation. Materials recovered from this area are distinct enough to support this interpretation. For instance, a very high percentage of the lithics recovered from this area (Area A) consist of coarse grained quartzite flakes and debitage, unlike the other areas of excavation. Faunal materials were generally more fragmented and poorly preserved, and the occupation layer here was much thinner compared to the central trench and western excavations. A broken pestle was also recovered from this eastern area. The projectile points recovered here, however, are definitely Besant.

There is a good possibility, however, that the sample itself was contaminated. Quite possibly it was contaminated through its exposure to erosional forces. It is just as likely that contamination occurred as a result of the sampling procedure. The eastern area of the site was the initial excavation test area in the 1986 season. Two one-metre units were started here after the test pits had revealed a cultural level. Excavations were halted here during the SAS Field School, which was concentrated in the central trench area. We covered the two units with an orange tarp to protect them from the elements. By the time we resumed the eastern excavations, algae had started to appear on some of the bones still exposed in the units. Although care was taken not to use these bones for samples, it is possible that small amounts of algae or mold were present, and not properly cleaned off. Also, this area is adjacent to the backfill from a large dugout, so it is not known to what extent it was disturbed during construction. It is regrettable that funding constraints did not allow the luxury of a second radiocarbon analysis from this area.

If sample S-2857 is rejected, it is clear that there is an overlap of the remaining dates between 1780 RCY and 1805 RCY at 95% standard error. If only the 67% error is used, it appears that two date clusters exist. Each of these clusters are located in different geographical areas of the site. The older dates (S-491, S-1640 and S-2855) were established in the south and central parts of the site, while the north and western areas produced more recent dates (S-1641 and S- 2856). Therefore, the suggestion that at least two separate occupations occurred at the Melhagen site is weakly supported by the radiocarbon analyis, and only if the 67% standard error range is used. There is evidence in the projectile point analysis and the faunal analysis which also suggests that more than one occupation period is present.

5.4) Discussion and Conclusions

The purpose of this chapter was to determine the age and the cultural affiliation of the Melhagen site. First, it was necessary to review the definitions of Besant and Sonota as they had been developed in the literature. It was found that these definitions are confused, largely because various authors were comparing different site types from different regions, and were using ambiguous definitions, especially in relation to projectile point morphology. Classification schemes are further confused because of disagreements over which taxonomic level is most appropriate for the Besant/Sonota culture. For the purpose of this thesis, the Melhagen site will be considered as a Besant phase site, largely because of the historical precedence of the terminology, the site's geographical location, the events that occurred there, and also because there is little reason to separate Besant and Sonota on the basis of projectile point assemblage characteristics.

The projectile point analysis was carried out to address a number of important issues. The first was to provide useful and comparable raw data to other researchers, including both metric and non-metric information. Second, it was important to compare this information with published data from other Besant and Sonota sites, to see if there really is much basis for cultural distinctions on these criteria. Meeting this second objective was difficult because much of the published information was either lacking entirely or was not directly comparable. The third objective was to see if different cultural groups could be distinguished at the Melhagen site by using metric and non-metric information in a statistical analysis.

Both of these types of data were examined in some detail. The PCA enabled the author to conclude that there is little basis for the separation of culture groups within the Melhagen site point assemblage. The very wide variation seen in this collection more likely reflects differences in the uses and the degree of reworking of

KRF and locally available raw materials. This is perhaps due to seasonal availabilty of KRF, the length and timing of site occupations and material preferences for different tasks.

It is likely that similar patterns exist at other sites. Furthermore, these factors probably contribute to the perceived difference in raw materials found in campsites, such as the Kenney site in Alberta, and kill sites found in Alberta, Saskatchewan and Manitoba. The paucity of information from kill sites in the Middle Missouri region makes this difficult to prove conclusively, but it should be examined in the future when such data become available. Again, it is important to emphasize that cultural factors should not be entirely excluded in this sort of analysis, but should be considered with other factors which may contribute equally to projectile point variation.

The systematic collection of quantitative and qualitative data from Besant site assemblages should eventually lead to better definitions of Besant and Sonota. Variations will no doubt be discerned across site types and regions on the Plains.

The radiocarbon dates are consistent with the time span of the Besant phase. The Melhagen site is one of the earliest known Besant kill sites this far north in the Plains, and is the only Besant kill site of its type known in Saskatchewan to date. The fact that the dates themselves are spread out supports the hypothesis that the site was used on more than one occassion in the Besant period.

CHAPTER 6

Frequency and Seasonality of the Kill Site Occupation

6.1) Introduction and Background

The radiocarbon date clusters (based on 67% standard error) discussed in the previous chapter suggested that there may have been at least two or more kill events at the Melhagen site. These events appear to be located in different horizontal bone bed locations over the site (Figure 1.5). It is entirely possible that kill and processing activity areas may be mixed within each of these bone bed areas, especially if the site was used repeatedly. Individual occupations of the site cannot be distinguished in vertical stratigraphic layers. The examination of the Melhagen site bison tooth eruption patterns will provide information for the establishment of the seasonality of occupation. Herd gender composition is also related to seasonality, since the sex ratio changes during the rutting season when bull herds join the female herds. Herd gender profiles may be used to support the tooth eruption evidence. Other researchers (Speth 1983) have also used gender studies to examine the possibility that the hunters preferentially utilized or selected male and female animals in the different seasons.

At least two possible interpretations could explain the frequency of kill events at the site. The first is that the site represents either one major kill event, or a series of kills that occurred within the same season across one or more years. Such an occurrence would be supported if all of the bison mandibular tooth eruption patterns indicated that the kill occurred in one particular season. A gender profile study would supposedly demonstrate herd composition that is consistent with that particular season. Lack of stratigraphic separation between kill events would indicate that only a few years had passed between each.

The second interpretation or hypothesis is that the site was utilized by the Besant people on at least two or more distinguishable occasions, which took place in two or more discrete seasons. This suggestion would be supported if the faunal evidence clearly shows patterns of bison mandibular tooth eruptions for several seasons of death. If this is the case, it is likely that kill and processing areas are so mixed that it would be impossible to separate them into discrete areas, even with stratigraphic provenience taken into account. Gender profile studies would reflect herd composition spanning different seasons.

The following information will show that the latter interpretation is supported by the faunal evidence. Furthermore, the stratigraphic evidence discussed in Chapter 2 does not by itself support or refute either hypothesis. The results of the seasonality evidence also prohibits any attempt to study the data in the same way that Speth (1983) studied the Garnsey site. Because no discrete separations of seasons are obvious either vertically or horizontally in the site, it is impossible to correlate gender selection preferences with seasons.

6.2) Mandible Studies and the Seasonality of the Site Occupation

6.2.1) Objectives

The seasonality study is critical to the interpretation of the Melhagen site. The objective here is to present the seasonality information in order to address the hypotheses outlined above. The data will demonstrate clearly that the site was occupied during several seasons. Whether this was one continuous occupation, or several visitations occurring over many years is not yet definite. Second, the separate bone bed areas may reflect different patterns of intensity of seasonal usage. Therefore, it is important to look at each area separately, and see if it was used more intensively in one season than another. Comparisons between areas can then be made to see how these patterns relate to the overall usage of the site.

6.2.2) Methodology

The seasons of site occupation were established through the study of bison mandibles recovered in excavations. Mandibles from both the Phenix and Ramsay collections were examined. They were sent to a specialist at the University of Brandon, Manitoba for analysis. A report prepared by the specialist (Peach 1990a) is in the possession of the author, and forms the basis of this discussion.

Bison mandible seasonality studies are based on the fact that the calving season peaks from late April to early May. Bison teeth erupt on a predictable schedule, so that the change in calf teeth can also yield a seasonality estimate. Such a study can provide an age profile of the archaeological bison herd, enabling the analyst to decide if the kill occurred in one single catastrophic event, or over a series of events (Reher 1974: 117-118).

The bison mandibles were aged following Fuller (1959) to some extent. Most were aged following the studies of Frison, Reher and Wilson (Frison 1970; 1978a; 1978b; 1982; Frison and Reher 1970; Reher 1970; 1974; Reher and Frison1980; Wilson 1980). Both tooth eruption and wear were examined in animals up to four or five years of age. After this age the mouth is mature. Thus tooth wear patterns have to be studied, although they are considered to be less reliable indicators of age. Incisors are considered to be the most reliable indicators of age, but they are seldom recovered in an archaeological context (Peach 1990a: 1). Premolars can vary up to two years in their eruption patterns, and so are not considered to be reliable for analysis. Thus molars are primarily used to determine ages in archaeological bison assemblages.

After a preliminary examination of the large amount of loose teeth recovered from the site, and because so many of the teeth were in a poor condition of preservation, Peach did not feel that a large time investment would yield any precise or useful results. Thus those samples which had complete or partially complete tooth rows remaining in the mandibles were used for this study. Maxillary teeth could also have been used, but there were too few to constitute a good sample.

The most badly fragmented mandibles were also omitted from the analysis because reconstruction of these specimens would require another large investment of time with limited results. Since large portions of the alveolar bone are missing or pulverized in these specimens, the degree of eruption would be almost impossible to determine with any precision whatsoever.

Mandibles with at least one intact molar, as well as refitted associated teeth were selected for study. The most reliable results would of course come from those specimens which also contained all the cheek teeth. The initial sample size of mandibles was 52. Three more mandibles from the Phenix collection were obtained and analysed. Thus, the entire sample used in the study consists of 55 specimens.

The first section of the analysis will present the mandible age and seasonality study completed by Peach (1990a). The second section will attempt to determine if the various excavation areas of the site reflect different intensities of seasonal use.

6.2.3) Analysis and Results

a) Mandible Age Groups

The information from Peach's (1990a) report has been summarized in Table 6.1. This table also provides the original provenience for each sample where it is available.

The evolutionary scheme of tooth nomenclature has been used in this analysis, and in the cataloguing system. Thus, terms such as P2 to P4 are used, rather than P1 to P3. The abbreviation of "P" has been used for premolars, "M" for molars, and the prefix "d" to indicate a deciduous tooth. The number indicates the position, such as first (1), second (2), third (3) and fourth (4).

The mandibles were first assigned to a yearly age group (e.g. 1-2, 4-5) and subsequently examined for differences, similarities and discreteness within each age group.

Age Group 1 - Zero to One Years;

For the first age group of 0 to 1 years, no mandibles were found.

Age Group 2 - One to Two Years:

Three specimens comprised the second age group of one to two years. Two of these are Catalogue Numbers 119 and #4438-4443, both of which are lefts. The first specimen contains M2, which had to be refitted, M1 and dP4. In the first, M2 is erupting, but not yet to the level of M1. No dentine has been exposed on M2, so little to no wear has occurred. M1 is moderately worn, while dP4 is present and worn. The fossettes of dP4 are still visible, however, and the roots are only slightly exposed. The second specimen consists of M1 and dP4.

In comparison to the Vore site aging scheme, #119's M2 is in eruption stage B/C, or late spring/early summer (Reher and Frison 1980; 65-68). The lack of the M2 in the second specimen, as well as the lack of M3's in both, limits the aging possibilities, as does the fact that the one M2 had to be refitted. A comparison of the wear on the M1's and dP4's from both mandibles indicates that the mandible lacking the M2 is slightly older. With a sample of two it is impossible to discern if these are variations in one discrete age group, or if they in fact represent two different age groups.

Mandible #1730-4 was initially placed within the next age group. The wear on M1 is similar to that of #1686-8, but the wear on M2 is indicative of an animal younger than two to three years. Wear is light on facets VII-VIII, which would suggest a late winter/early spring kill, or at approximately 1.9 to 2.0 years. Unfortunately, M3 is not present, which limits the aging somewhat.

<u>Age Group Three - Two to Three Years</u>:

This group consists of only one specimen. Mandible #1686-8 has P2 and P3 erupting with dP4 pushed upward by P4, which is just becoming visible above the alveolus. M3 is erupting with 1.5 cusps visible above the alveolus. This sets the animal at somewhat less than 2.5 years, with a seasonality estimate of early fall. Reher and Frison (1980: 65) state that by 2.5 years, the first two sets of cusps may not be fully erupted. This correctly describes this mandible.

Age Group 4 - Three to Four Years:

This age group can be divided into subgroups. In one group, mandible #9618 shows wear on M3 cusps I and II, with the hypoconulid above the alveolus. This is substantially younger than 3.6 to 3.7 year age groups, and actually seems to be of spring/summer age, since in spring the hypoconulid emerges and by fall wear should be on cusps III-VI.

Mandible #9782 is a right mandible that has P2 and P3 fully erupted, with P4 approximately three quarters of the height of the other teeth. M1 and M2 are fully erupted and in wear. M3 has all cusps above the alveolus, but examination of wear is impossible as the cusps are badly broken. Since the hypoconulid is well above the alveolus, a fall estimate is plausible for this specimen. However, since specimen #9782 is definitely younger than other mandibles in the three to four year age range, an earlier date is also possible.

Specimen #10919 is a right mandible containing dP4, P4, M1, and M3. The M1 exostylid is in wear, but still a circle. The dP4 is being pushed out, with the roots well exposed, and P4 is visible beneath. M3 is still in the process of erupting, with the hypoconulid above the level of the alveolus and wear on the anterior facets. Dirt has been varnished to the teeth, obscuring the wear to some degree. Using Frison and Reher (1970), the mandible has been aged to a late summer/early fall period, at approximately 3.6 years. As the eruption schedule of premolars tends to be more variable than for molars, the fact that dP4 has not yet been discarded is not anomalous.

Mandible #1582 has the M1 exostylid well in wear, with wear on M3 moderate on facets I-IV, and light on V and VI. This seems to place the seasonality of this specimen during the fall.

Mandible #9621 contains only M3. Wear on this tooth is well progressed from facets I-VIII. This seems indicative of a late fall to early winter kill. Mandible #9615 has more wear on M3 than does #9621, but the hypoconulid is virtually unworn. This can be considered consistent with #9621, and is probably slightly later.

Age Group 5 - Four to Five Years:

This four to five year age group includes mandibles #4526, #16, #9156, #9732, and #9616. These mandibles exhibit an internally similar wear pattern, with M3 worn across all facets, M2 exostylid almost in wear, and M1 exostylid worn to a loop, or almost a loop. At this age, seasonal determination is less precise, since wear is more variable than eruption. The fairly high degree of wear on the M3 hypoconulid seems to indicate a winter/spring kill, while the exostylid wear seems variable.

Age Group 6 - Five to Six Years:

The five to six year age group is quite large. Mandibles #2345, #4901, #4795, #9783, #9658, #9638, #9147, and #6737 correspond with a fall kill, while #266, #5463, #9619 are older, with the M2 exostylid a loop, and the enamel base at the M1 metaconid at, to above, the alveolus. Specimen #6654 contains only the PM4 and M1 and is therefore difficult to age. It does, however, fall within this five to six year group, as the M1 metaconid is close to level of the alveolus, and M1 is not deteriorated.

Mandible #10918 is a left mandible fragment containing only M3, so it is not possible to establish the season of death. The hypoconulid of M3 is broken. However, it does appear that it is joined to the other cusps (i.e. the enamel is continuous). The exostylid is not yet in wear. Using Fuller (1959), and Frison and Reher (1970), the mandible can be aged to the five to six year age group. The tooth also appears to be very large.

Age Group 7 - Six to Seven Years:

The six to seven year age group again contains more than one subgroup. In one, including #9639, #9765, #6733, and #9808, the M3 exostylid is just coming into wear. Mandible #10920 contains M2 and M3, while #10921 contains the corresponding P3 to M1. These represent the remains of the same right mandible. All teeth are mature, with the M1 exostylid worn to a loop, the M2 exostylid worn to a circle but tending towards a loop, and the M3 exostylid a circle. Wear is evident across all facets of M3, with the enamel of the hypoconulid continuous with the rest of that tooth. The enamel line of M1 is above the level of the alveolus, while that of M2 is below. Some cupping is present on M1. This mandible corresponds to a 6.6 to 6.7 year age, with a seasonality estimate of fall.

Mandibles #48, #1749, #6656, #9617 are older, with exostylids well worn. Again, the first group fits with a late fall kill, with the second group possibly winter to spring. Mandibles #9141, #9142, #9153, and #10072 contain only M1's and M2's, but do seem to fit in the general year group.

Age Group 8 - Seven to Eight Years:

Nine specimens fit into the seven to eight year age group. In all of these, the M1 has clearly deteriorated. Again, there is some age range. Of note are mandibles #9152 and #9766, both of which have the M1 prefossette worn away while the tooth is deeply cupped. The prefossette on #9767 is almost gone, with others showing clear deterioration. In all of these mandibles, the M3 exostylid is worn to a circle. No seasonality estimates can be determined from this age group.

Age Group 9 - Eight to Nine Years:

Mandibles #9764, #9763, and #118 are all contained within the eight to nine year age group. In these specimens, the M1 prefossette is worn away, while the postfossette is nearly so. Cupping is evident on M2. The M2 metaconid enamel base is above the alveolus, with the M3 close to the alveolus. The enamel on the anterior portion of M1 is worn to the root. M3 exostylids are loops or nearly so. Seasonality estimates are not possible for this age group.

Age Group 10 - Nine to Ten Years:

Mandibles #9620 and #9734 fit within the nine to ten year age category, or may possibly be older. The enamel base of the M3 metaconid is well above the alveolus, with the M3 exostylid worn to a loop. The enamel of the anterior portion of the M2 is gone. However, deterioration does not seem to be extreme. Mandible #9620 also exhibits a congenital lack of P2.

b) Discussion of the Age Group Study

The number of mandibles in each age group has been plotted in Figure 6.1. This profile shows the complete lack of first year calves represented in the mandible collection, with only a few second and third year animals. The majority of the sample falls within the three to eight year olds, and animals older than ten years also seem to be underrepresented. Such a pattern differs quite sharply from the age profile of a natural population suffering a catastrophic kill event (see Reher 1974:118; Frison 1978b: 296), and therefore supports the hypothesis of an attritional kill. However, the Melhagen profile does not seem to match the typical attritional kill profile either. The overall distribution seems to roughly follow that of the Casper site (Reher 1974: 119), but differs in that the Melhagen sample totally lacks animals up to two years of age. The Casper site, which was a fall kill, produced 18 calf specimens, and lacked animals which were between 0.6 and 1.6 years of age. The population profile of the Melhagen site is probably related to the fact that the site was used over several seasons (see below). This makes it difficult to compare to other sites in which the kill event took place in one season, in one or more years.

The lack of foetal and young animals is common in the age profiles of prehistoric bison kills over much space and time (Reher 1970; 1973), and has been discussed at some length elsewhere (Frison 1978b: 296-297, Reher 1973: 96-97, 102-105). It most likely reflects a combination of natural and cultural factors. Young calves could be underrepresented simply because they could not keep up with a herd as it was being driven. Historical accounts show that foetal and young animals were often selected for their soft hides, which were suitable for winter clothing, and for their tender flesh (Reher 1973: 103; Verbicky-Todd 1984). Reher and Frison

(1980: 75) noted that animals up to two years of age could easily be reduced into small units and removed from the main butchering area. This would give the hunters enough maneuvering space to tackle the larger animals (cf. Halloran 1960; Novakowski 1965).

Furthermore, the bones of foetal and young animals are small and often quite porous, which makes them quite susceptible to destruction through weathering and other taphonomic processes. Although this is not considered a serious factor in sites with excellent preservation, it is definitely something to be considered at the Melhagen site, since many materials were badly deteriorated, especially on the surface of the bone beds and in the eastern excavations. Also, carnivores often chew the soft ends of adult long bones and foetal materials in order to get at the bone marrow. One foetal metapodial recovered from the site had definitely been chewed by a carnivore. Other foetal and neonate remains were recovered from across the site, albeit in small numbers.

Most of the animals in the Melhagen sample were between three and eight years old at death. Animals in the two to three year age bracket also have lower than expected representation. It could be that a high mortality rate among calves two years previous to the kill lowered the numbers of this age group. These animals would also have provided good skins, so were perhaps removed to another area by the hunters.

The age profile also shows a lack of animals which were more than 10 years old at death. This lack of older animals may be due to the fact that the Melhagen site older animals do not show excessive tooth deterioration, or, perhaps the very old age groups did not constitute a significant number of the original herd. Since very old animals (between 10 and 16 years) exist in relatively small numbers in natural populations, their lack in the Melhagen population may be due to sampling error.

c) Seasonality and Site Usage

Examination of the age group data shows that the Melhagen mandibles do not group into good discrete samples. The seasonality ranges from fall to late winter or early spring. The seasonality data for the entire mandible collection has been summarized in Figure 6.2.

Overall, it seems that the use of the site is similar to Reher and Frison's (1980: 66) interpretation of the Vore site, where "driving of buffalo began in the late fall or early winter and reached a peak some time during or shortly after the calving peak, in late spring or early summer. Driving then rapidly dropped off towards the fall, with perhaps a pause until the next season began." The Melhagen site differs in that the driving began very intensively in the fall, steadily continued well into the late winter or early spring, and dropped off by late spring. Carcasses that froze in the fall and winter kills could be used as a storage supply for the whole winter. Historical observations (Hind 1971 *i* : 357) note that the carcasses could pile up in the pound two or three deep after one drive, and successive drives could deepen the pile even more. The density of bone beds at kill sites confirms this. In the coldest times of the winter, temperatures on the Plains sometimes sit at -40° C for weeks. Under these conditions deeply piled carcasses would freeze together quickly and solidly, making it very difficult to reach animals at the bottom of the pile. Butchering these frozen carcasses would be much like trying to carve a piece of rock with a flint knife. Thus, it would be important to complete most of the butchering when the kill was relatively fresh and not frozen solid. Portions of the animals would have to be removed to the periphery of the kill site away from the pound, and to the campsite for storage and processing. Still, some carcasses at the bottom of the heap were perhaps never touched. It would be advantageous to conduct successive kills to assure a fairly consistent supply of easily-managed meat.

The smell produced by a kill this size must have become intolerable after the spring thaw. Hind (1871*i* : 355) remarked that the stench that arose from one pound site in the Elbow sand hills got so bad that the Indians abandoned it. This could explain why the hunting activity was reduced in the spring and summer. Furthermore, there is some evidence that the quality of the body fat and nutritional value of the cows was seriously depleted by this time of year (Speth 1983: 102-103). At such a time, hunters tended to concentrate on bulls since they were in better condition in the spring than the pregnant cows. Bulls were in poor condition during and after the rut. Aboriginal hunters knew this and concentrated on the gender with the highest seasonal nutritional value in their hunting strategy and during the butchering (Ewers 1958: 76; Grinnell 1972: 269; Southesk 1875: 80).

Concentration on bull herds during the calving season could also help to explain the complete lack of neonates, but does not explain the paucity of foetal materials in the sample. If the last series of drives in the late spring were concentrated on bull herds, then the low number of foetal materials could be accounted for.

However, bull herds behave differently than cow-calf herds in that they usually graze apart from each other and scatter in all directions when started (McHugh 1958: 16). This characteristic would make them extremely difficult to successfully drive into a pound. The gender analysis should help to address this possibility.

If this site was used more or less continuously for an entire winter, or in multiple uses spanning several years, then there is some chance that different areas of the site could show more intensive usage in one part of the year as opposed to another. The author attempted to test this by studying the provenience of each analysed mandible. It was hoped that at least one bone bed area would exhibit an association with one seasonally restricted occupation. The seasonality of each excavation area is represented in Figures 6.3 to 6.6.

A number of problems become apparent when this approach is taken. First, not all of the excavation areas are represented by analysed mandibles. Those from the eastern side were not included because they were too fragmented and scattered to be reliably assigned to age groups and/or seasons, or even to single mandibles. Also, only one mandible was accurately assigned to a season from the very large southwest Phenix excavation units (Area D). Mandibles from this southwestern block are radically underrepresented because provenience information was lost during their years in storage. This loss is regrettable, especially when one sees the large number of mandibles represented in the field drawings. No doubt many of the hundreds of loose teeth with no provenience come from this area. There is one mandible that was assigned to a fall kill

(#9147), but it has no provenience. This specimen is from the Phenix collection, but cannot be assigned to either the northwest (Area E) or the southwest Phenix units with any degree of certainty.

The overall pattern of seasonal usage of the site is shown independently at each separate excavation area. In other words, there does not appear to be any area where the hunters concentrated their activities in one particular season. The lack of horizontal patterning also helps to explain the complete lack of stratigraphic separation between events. Unfortunately, there is not enough provenience information to separate seasons in the stratigraphic profile either. This problem is exemplified in one of Phenix's five-foot excavation units (90W 65N). In it there are two mandibles from the fall, three from the late fall/early winter, one from the late winter/early spring, one from the late spring/early summer, and one from the late summer/early fall. Clearly the mandibles were removed, mixed and scattered all over the site by humans and carnivores. There is little doubt that the rest of the bison carcasses were similarly treated.

The lack of seasonal separation across the site is important because the author had hoped to study the relationship of gender preferences in bison utilization within different seasons. Such a study would have followed Speth's (1983) methodology, and it could have provided some interesting comparisons between Northern Plains and Southern Plains sites. Without good seasonal separation, however, this sort of study is impossible. It would be even more complicated by the fact that the preservation at the Melhagen site is relatively poor compared to the Garnsey site, and also because the Phenix collection's provenience data was lost.

6.2.4) Summary of the Mandibular Seasonality Study

The seasonality study of the Melhagen site has yielded some important information. First, it is clear that the site represents either a continuum of bison drives extending from the fall of one year into the late spring of the next, or a series of multiple kill events in different years in different seasons. The nature of the seasonality data seems to slightly favour the first interpretation, but it is not totally conclusive. It should also be noted that the boundaries of the excavation blocks and trenches may not necessarily coincide with discrete activity areas (ie: kill area vs. processing area), even though the excavation blocks appear to be well-separated in different site areas.

6.3) Gender Studies and Seasonality of Site Occupation

6.3.1) Objectives

Gender studies are important to the study of archaeological kill events because they give a much clearer picture of the type of herd that was successfully killed at the site (ie: nursery or bull herd), and can either augment or provide a contrasting result to the seasonal information drawn from mandibular sources. Once the analyst has a good demographic profile of the herd, "it is then possible to assess the procurement methods used because nursery herds behave differently than groups of mature males" (Frison 1978b: 298). Inferences about the size of the human group involved and other economic activities can also be made in some cases (Frison 1978b:

298). Thus information from this section will have implications in the interpretations made in later chapters.

6.3.2) Methodology

There are a number of ways of establishing gender profiles. Some of these methods are more reliable than others, as they rely on different data sets from bone elements. Volume measurements of astraguli have been used to indicate size differences in bison populations (Lorrain 1968; Sellards 1955; Zeimans and Zeimans 1974). Measurements on metacarpals and metatarsals have been used to distinguish male and female bison in archaeological herds (Bedord 1974;1978). The height of mandibles below M3 has been used by Reher (1970, 1973, 1974) to establish gender profiles in many sites excavated by Frison. This method produces bimodal distributions, but does not tell us where the exact separation of male and female mandibles can be made on the size scale (Frison 1978b: 299). A discriminant function analysis study of front first phalanges has also been developed (Roberts 1982) to establish the sex of Plains bison, and has also been used to trace evolutionary changes in bison.

These types of studies are useful largely because they rely on body parts that are usually plentiful in archaeological sites. Analysts may use one, or preferably several of these to establish gender profiles of the archaeological herd. Phalanges and metapodials have a low meat yield but a high oleic acid fat content, which was apparently considered to be more palatable than marrow from the higher limbs (Binford 1978: 102; Speth 1983: 102-103). They are also fairly plentiful in most archaeological assemblages. At least two major sources of bias may be introduced into gender studies which rely soley on complete elements. Walde (1985: 7) summarized these problems as follows:

> Archaeological collections are, *a priori* , limited by problems of differential deposition and preservation and by the extent of excavation of a site. Any effort to overcome these problems must involve an attempt to use as much of the collection as possible. By concentrating upon whole elements, an investigator would be using a very small portion of an already limited sample. A second form of bias involves the possibility of gender-based processing decisions made prehistorically. If, as Speth (1983) suggests, seasonal differences in the fat content in the marrow the same elements of each gender led to gender-based processing decisions, then, by concentrating upon whole elements, an investigator could unknowingly describe only the gender of material rejected by the prehistoric people. Gender ratios of the hunted animals and the utilized animals would not be recoverable.

Recently Walde (1985) developed a methodology of discriminant function analysis that can be applied to proximal and distal ends of long bones, and which does not require whole bone elements. Twenty-nine equations utilizing different sets of measurements on various long bones were developed and tested against a known-gender sample. At least two equations were developed for each element end, so elements with broken portions do not necessarily have to be omitted from the sample. Tests showed that the equations correctly assigned gender with a minimum accuracy rate of 90%. Walde did caution, however, that this method should not be used with bison materials that are older than six thousand years because of evolutionary changes which have reduced the body size of bison over time. This method is particularly useful for the Melhagen site materials as many long bones recovered from archaeological sites are incomplete.

The following study will examine data from the Melhagen site utilizing three methodologies: Roberts (1982) sexing technique on bison front first phalanges, Bedord's (1974; 1978) technique which uses complete metapodials, and Walde's (1985) discriminant function analysis of proximal and distal ends of long bones. Because the vast majority of the mandibles were broken below M3, there will be no attempt to utilize a mandibular height analysis. Some of these mandibles were probably broken to obtain marrow, but most seem to have been broken by roots and weathering. By examining gender profiles of both preferred and non-preferred bone elements, we will be able to better interpret the seasonality data and the preferences of the hunters.

It should also be mentioned that despite the large number of animals killed at the Melhagen site (an MNI of 173), there are relatively few elements that are well enough preserved for these gender studies. This is an important problem and its implications will become more apparent in the following chapters.

6.3.3) Analysis and Results

a) Application of Roberts' (1982) Technique to *Bison bison* Front, First Phalanges

This technique is widely used in Manitoba, and Peach (personal communication 1989) suggested that it could be useful for the Melhagen materials. She examined all first phalanges from both the Phenix and Ramsay collections, and complete mature ones (those with fused epiphyses) were selected for the analysis. Both collections were used so that a more reliable sample size of 32 could be obtained.

Several of the phalanges from the Phenix collection had to be omitted from the study because of their poor condition. Many exhibited a high degree of exfoliation and disintegration due to the flooding which occurred while they were in storage. Others appear to have been smashed to obtain marrow, but this is difficult to prove because of the damage suffered in storage, and also because of natural weathering prior to excavation. While the Ramsay phalange collection was in better overall condition, natural weathering certainly reduced its sample size as well. The following information is based on Peach's (1990b) report.

The phalange collection was first divided into front and rear through the examination of proximal ends (Roberts 1982: 57). Three measurements were taken on each specimen: length (L), greatest length (GL), and distal height (DH) (Roberts 1982: 36-43). Each measurement was taken twice to ensure accuracy. If both measurements were not the same, a third was taken and an average computed for the three measurements. The values were utilized in the discriminant function equation:

(GL x 0.52067) + (DH x 0.54678) - (L x 0.29469) = Index.

In Roberts' (1982) own study, this equation had resulted in a complete separation of males and females in two known sex samples, and a clear separation in her archaeological test sample from the Stott site (Peach 1990b: 3).

The raw data of the phalange measurements is provided in Table 6.2. The indexes have been plotted in Figure 6.7 in a histogram. The Phenix and Ramsay collections had initially been studied separately, but the results of each were so similar that it is more useful to discuss them together. It should be remembered that all mature, measurable phalanges were used, and that one individual may be represented by one or more phalanges. Also, a similar index figure does not necessarily indicate similar individual measurements (Peach 1990b: 2).

Separation between females and males on the discriminant function scale occurs between 30.6 mm and 31.68 mm. A female to male ratio of 26:6 or 13:3 is clearly evident, which means that about 81% of the phalanges are female and 19% are male (Peach 1990b: 2).

Following McHugh's (1958: 15) bison herd composition statistics, this low percentage of males may indicate a cow group during the late winter/early spring season, when few mature males (those over two years of age) were integrated into the cow groups.

Peach (1990b: 3) noted that variations in the sex composition of the faunal assemblage may be due to cultural factors as well as to the original herd composition. Hunters may have driven herds which had the desired sex and age composition. Again, butchering differences based on sex could have affected the ratios seen here.

b) Application of Bedord's (1974;1978) Technique to Complete *Bison bison* Metapodials

Bedord's (1974; 1978) methodology follows Lorrain's (1968) work on metapodials. It is a multivariate analysis as it relies on more than one measurement. Bedord (1974: 199-240) compared data from several sites and found that Lorrain's (1968) Ratio 6 was the most useful for predicting gender divisions in bison populations. Ratio 6 data is measured in millimetres and is calculated as follows: Ratio 6 = (Transverse width at center of shaft / Greatest length) x 100.

This ratio must only be applied to mature metapodials, which have completely fused epiphyses. Fusion of epiphyses takes place by the end of the fourth year of life (Koch 1935).

The results of this ratio are then plotted against the width of the distal end (mm). The produced scattergram demonstrates clustering of male and female elements. Bedord (1978: 43) warned that a minimum of 20 bones for each element is required for a good sample. Smaller samples "may have more than one separation in the clustering, and this would make determination of the "true" separation difficult" (Bedord 1978: 43).

Metapodials from both the Phenix and Ramsay collections were used in order to obtain the largest sample size possible. Even so, only 11 complete, mature metacarpals and five complete, mature metatarsals were suitable for the analysis. Thus the conclusions reached here must be approached with some degree of caution. Despite Bedord's warning, however, good clustering has still been produced.

Each measurement on the bone elements was taken three times by the author. Averages were calculated, and may be found in Tables 6.3 and 6.4. Ratio 6 was then determined for each metapodial element, and the result was plotted in Figures 6.8 and 6.9.

The clustering of male and female metapodials is clearly demonstrated in these Figures. The ratio of sexed females to males in the metacarpal analysis is 7:3. This means that 70% are female and 30% are male. One specimen (#2921) was indeterminate. It was also tested with Walde's method, and inconsistent results were produced on the proximal and distal ends. This will be discussed later in this chapter. The ratio of female to male metatarsals is 3:2, which means that 60% are female and 40% are male. The sample size for both is very small, however, and so it would be incorrect to assume that these figures reflect the reality of the archaeological bison herd demographics.

It is of some interest that several more metacarpals were recovered intact than metatarsals. In fact, complete mature metacarpals outnumber similar metatarsals two to one. Broken metatarsals outnumber broken metacarpals. This seems to be consistent with the idea that forelimbs were less desired than hind limbs. A few immature specimens were present in both the Phenix and Ramsay collections but could not be used in this analysis.

c) Application of Walde's (1985) Technique to Distal and Proximal Ends of *Bison bison* Long Bone Elements

Very few of the long bones recovered in both the Phenix and Ramsay excavations were intact. This fact alone makes the application of Walde's (1985) technique especially appropriate. One humerus found in the Phenix collection (with no provenience information) was relatively complete, but the shaft had been punctured with a heavy blow in order to obtain the marrow. Weathering and storage conditions deteriorated the proximal and distal ends to the extent that the bone could not be used in this analysis.

Walde tested the measurements that had been set out by Speth (1983: 172-191). These followed the procedures and terminology described by von den Driesch (1976), and some terminology was also drawn from Getty (1975), Olsen (1960) and Brown and Gustafson (1979). He eliminated measurements which were too difficult to take with consistent accuracy, and derived the multivariate discriminant function equations discussed earlier in this chapter. These equations will not be listed here since they are produced in Walde's thesis (Walde 1985: 51-58). These were tested against a known sample for their accuracy.

A male group and a female group equation was derived for each equation. As an example, Equation One from the proximal humerus will be presented.

The male group equation of Equation One is:

$$M = -9.677928(C) + 31.61367(D) + 35.38570(E) - 3.157891(F) + 30.15858(G) - 417.0617.$$

The female group equation of Equation One is:

$$F = -5.408166(C) + 22.42634(D) + 26.54183(E) + 1.530750(F) + 21.17843(G) - 272.9888$$ (Walde 1985: 51).

The result of the female equation is then subtracted from the result of the male equation. If the difference is lower than -1.6, the bone is assigned to the female gender. If the difference is higher than +1.6, the bone is assigned to the male gender. Any value between -1.6 and +1.6 cannot be assigned to either gender, as it could represent an immature animal of either gender.

The author followed the measurement descriptions and figures provided in Speth (1983: 172-191), and conducted each measurement three times with the appropriate calipers. An average value for each variable was employed for the subsequent calculations. This data was then entered into a Macintosh Excel program with the equations and was subsequently analysed. The raw data and gender results for each proximal and distal element used are provided in Tables 6.5 to 6.17.

It should be noted that in some cases, results from different equations on the same element produced slightly different results. This generally occurred if the bone was on the borderline between male and female. In most of these situations, a third equation often produced a strong association with one of the genders. If the results of all applicable equations were between -1.6 and + 1.6, no gender was assigned. In a couple of cases, however, one equation produced a strong male association while another produced a strong female association on the same element. These situations are probably the result of the author's minimal experience in measuring bone elements, and the fact that the measurements were not always well-depicted in Speth's (1983) text or drawings. The assignment of gender in these cases was made after careful consideration of other equation results where possible.

<u>Proximal Humerus</u>: No proximal humerus elements were complete enough for analysis.

<u>Distal Humerus</u> (Tables 6.5 and 6.6): Nine distal humeri were included in this study. Six were rights and three were lefts. Walde (personal communication 1990) warned the author that male

humeri tend to break during butchering with the distal end as a complete unit, probably because they are more robust. The distal end of female humeri, however, tends to split along a vertical line, separating the condyle into two chunks. Thus, if only complete distal humeri are used, the sample is biased towards males. A few humeri were broken like this, and had to be dropped from the analysis because they were missing other vital portions. Therefore, the ratio of five females to four males (56% F: 44%M) reflects this bias towards males to some degree. Given the small sample and the lack of proximal humeri for comparison, it is impossible to assess the degree of this bias.

Measurement "K" (Greatest depth of medial epicondyle) had to be omitted in three cases because the proximal edge of the trochlea was chewed or weathered. The soft, spongy bone found on the rounded articular surfaces of long bones was often chewed by carnivores in an attempt to reach the marrow cavity.

Proximal Radius (Tables 6.7 and 6.8): Six left and 10 right proximal radii were measured for a sample of 16. Of these, 12 were female and four were male. (75%F: 25%M). Sample #2892 originally was not assigned to gender because three equations determined it to be male, two determined it to be female and one equation left it as a possible female. The three equations which produced the female association all used Measurement "C" (Depth of capitular articular surface) which is difficult to consistently replicate. For this reason, equations using Measurement "C" were dropped in this case and the element was assigned to the male gender.

Distal Radius: Although both collections contained a number of distal radii, they were dropped from the analysis. The author found that it was virtually impossible to get consistent results on the majority of the measurements. After some consultation with technicians working in Alberta (Alison Landal, personal communication 1990), it was found that this is such a common problem that the distal radius is ignored in most studies.

Proximal Metacarpals (Tables 6.9 and 6.10): Seventeen proximal metacarpals comprised of nine lefts and eight rights were utilized. Of these, 11 were assigned as females and six as males (65%F: 35%M). Specimen #2921, which was classified as "indeterminate" with the Bedord analysis was initially classified as a female here. No major difficulties were experienced in taking the measurements on this sample, so all genders have been assigned with confidence.

Distal Metacarpals (Tables 6.11 and 6.12): Seven left and 11 right distal metacarpals were analyzed. Ten were assigned as females, five as males and three were not assigned to gender (66%F: 34%M of sexed elements). Specimen #2921 was classified as a male in this set of equations. This conflicts with the results from the proximal end and the Bedord study, so it will be classified again as "indeterminate." This result is consistent with that of the proximal metacarpals. Sample #3286 produced three very weak female associations, and sample #10094 produced two weak male and one weak female associations. Because they cannot be assigned to gender with any confidence, they will be dropped from further consideration.

Proximal Femur; Distal Femur; Proximal Tibia: None of these three element categories contained any elements suitable for analysis. The lack of these posterior long bone portions is quite significant and will be discussed in the next chapter.

Distal Tibia (Tables 6.13 and 6.14): Seventeen distal tibias were measured. Of these, eight were lefts and nine were rights. Female gender was assigned in 11 cases, male gender in four cases and no gender was designated to two of the elements (73%F: 27%M of sexed elements).

In sample #2957, Equation One produced a male result while Equation Two produced a female result. It is assumed that this is a product of the difficulty the author had in taking Measurement "J" (Greatest breadth of lateral and medial articular grooves) with consistent results. Another source of error could come from the equations themselves. Walde (1985: 57) found that Equation One grouped 96.67% of 30 known cases correctly, and Equation Two only grouped 90% of 30 known cases correctly. These two are among the less reliable equations he provided.

Sample #7585 produced one weak female and one weak male association, and so it is likely that this specimen is from a young animal (probably male). Since the proximal end is not available, there is no way of knowing if this element is actually mature or not. In light of this, it will be dropped from further discussions.

Proximal Metatarsal (Table 6.15): Of the 23 proximal metatarsals used in this study, nine were lefts and14 were rights. Gender was assigned to 14 females and five males (74%F: 26%M of sexed elements). As well, three weak female and one weak male associations were made. All four of these last cases are probably representative of young animals, and will not be considered in the rest of the analysis.

Distal Metatarsal (Tables 6.16 and 6.17): Ten left and 16 right distal metatarsals were examined. Of these 26 specimens, 13 were female, eight were male and five could not be assigned to a gender (61%F: 39%M of sexed elements). In all five of the cases which could not be assigned, Equation Three seemed to produce the anomalous gender. This is the only equation which includes Measurement "J" (Depth of lateral sagittal ridge), so it is possible that the author had some difficulty with it, although it was certainly not seen as a problem at the time. It is more likely that these elements represent younger animals, and so will not be considered in the analysis.

6.3.4) Summary of the Gender Studies

In all of the gender anlaysis methodologies used in this section, it was shown that females have a higher representation in the archaeological herd than males. The reliability of each method is reflected in the fact that these results are repeated regardless of which is used. This is underscored also by the fact that specimen #2921 produced ambiguous results in each study.

The highest ratio of females to males was seen in the study of front, first phalanges, while the lowest female to male ratio resulted in the distal humeri. Given the problems mentioned earlier with the distal humeri and the small sample size, it is clear that the humeri results should be used only with great caution.

The distal metatarsal sample contains the highest MNI, with 15 right elements represented. The ratio produced with the distal metatarsal sample (66%F: 34%M) could therefore reflect the most statistically reliable sample of all, although the phalange data results (81%F: 19%M) should not be ignored either. The reduced female representation in the distal metatarsal data could actually reflect the higher utilization of female metatarsals compared to the non-utilization of phalanges in either gender.

Every gender profile supports the mandibular study in that there is little resemblance to the expected gender profile of a summer kill. All results reflect to varying degrees male integration into a cow-calf herd during the fall rut.

Earlier in this chapter it was suggested that hunters may have concentrated on bull herds towards the end of the winter. Because they are difficult to drive as a cohesive unit, this hypothesis is hard to support. If such efforts were made, it is likely that only a few bulls were successfully brought in and slaughtered in any one attempt.

As was the case with the mandibular seasonality study, a preliminary attempt was made by the author to see if gender groups were clustered in specific bone bed areas across the site. It became readily apparent that such clustering was not evident. This fact has direct implications for the direction of the remaining analysis.

6.4) Discussion and Conclusions

At the outset of this chapter, two hypotheses were put forth as possible explanations of the frequency and seasonality of occupation of the Melhagen site. It was shown in Chaptert 2 that the stratigraphy revealed a single occupation layer, but it was not clear if multiple occupations within it had been obscured by loadcasting and/or trampling. The horizontally spaced bone beds appeared to indicate multiple uses of the site. It was clear that the stratigraphic data alone could not reliably indicate how many times this site was used.

The faunal data was more useful. The population profile of age groups could not be directly compared to other known kill sites. The profile does loosely resemble that of the Casper site, with the exception that the Melhagen site totally lacks mandibles from foetuses, neonates and animals up to one year in age. Young animals are tremendously underrepresented, considering the composition of a living herd's natural population profile. Several natural and cultural factors were offered to explain the lack of young animals. These include a high removal and/or utilization rate of these age groups by the hunters, as well as factors of weathering, scavenging and loss in storage.

The seasonality data demonstrated that like the Vore site, animals were killed during several seasons. The Melhagen data shows that the initial kill event probably occurred in the fall, and that hunting continued at a high intensity throughout the winter. It appears to have fallen off in the spring, and virtually ceased in the summer. Although it was suggested that the late spring drives could have concentrated on bull herds, little or no supporting evidence was found, other than inferences based on the paucity of foetal material. Several gender analysis techniques reflect a typical fall to winter herd population profile.

CHAPTER 7

Interpretations of Site Activities

7.1) Introduction and Background

The discussion up to this point has dealt with two major interpretive problem areas: the site's age and cultural affiliation, and the frequency and seasonality of its usage. Environmental (Chapter 2) and ethnohistoric (Chapter 3) information have already been reviewed, and provide much of the background for the discussion of the third problem area: the interpretations of site `activities. This particular problem is concerned with two types of site activities, including hunting strategies used by the Besant peoples, as well as processing and utilization patterns.

The discussion of hunting strategies is based primarily on previously-presented information. Processing and utilization patterns will be interpreted on the basis of theoretical concepts of hunter-gatherer utilization preferences, as well as on the distributions of archaeological materials across the Melhagen site.

7.2) Hunting Strategies Used at the Melhagen Site

One of the most important aspects of a communal bison hunt involved the way that the features of the landscape were incorporated into the hunting strategy. Decisions made in this regard had a direct effect on the outcome of the hunt. In the Elbow sand hills, the terrain is fairly subtle, and the Melhagen site terrain does not appear to differ from most of the surrounding area. It is therefore clear that certain features must have existed in the past which made this spot suitable for bison kill events on several different occassions.

Sand hills are subject to periods of erosion and stabilization which can drastically alter the appearance of a locality over time. It is likely that some features of the area have changed since the site was occupied: surrounding dune ridges were probably higher than they are now, and the depression was at a lower elevation. Aspen and willow trees may have been attracted to the high water table here in the past. These features would have made this spot appropriate for a communal bison hunt.

The technique used to entrap the bison herds must be examined. In Chapter 3 it was noted that communal hunts in pre-horse days employed primarily the bison jump, the surround or the pound technique. Often the hunters would integrate natural traps into the pound technique. Given the fact that the site is not located near the base of any steep embankment, or even a remnant of such terrain, it can be safely said that the bison jump technique was not used here. It must therefore be decided if the surround or the pound technique was used.

If there was a complete absence of post holes at the Melhagen site, it would be simple to claim that the surround technique was used. One possible post hole feature was found, but it was weakly defined in the soil and does not by itself preclude other explanations of hunting methods. Historical documentation shows that the surround was a preferred method of hunting in the summer, so the seasonality evidence would have had to show that the kill occurred in the late spring through to the early fall. Already we can see that this hypothesis is weakened by the fact that the hunt was concentrated from the fall to the early spring. Furthermore, the bison would certainly avoid the area after one kill event had taken place, since it would reek of humans and offal for some time. Thus it is unlikely that several consecutive surround kills would have taken place in the same spot. The bison would have to be brought to the site from elsewhere to be slaughtered.

It is more probable that the Besant people employed an impounding technique at the Melhagen site. The general topography of the area would indicate that the kill took place between two parabolic dunes, which have since been eroded. It is not known from which direction the bison were driven into this area, but the topography, the configuration of the bone beds and the prevalent wind directions would suggest that the herds were likely driven from the north, northwest or west. This is one question that will probably never be satisfactorily answered, since no evidence of drive lanes was found in any direction around the site.

If trees were growing in the depression of the site, some were probably used as support posts for the corral, and others were cut down and used to build the fence. The pound likely had to be cleaned out and repaired after each kill event to accomodate new herds. It is possible that walls were moved and the kill area expanded from time to time.

Given the seasons of the hunt and the high water table, it is likely that the ground was frozen for a good portion of the site's occupation. This would make it difficult to dig post holes. Historic records showed that pound enclosures were often flimsy, and only had to appear to be solid to be effective barriers. This could also explain the general lack of post hole features across the site. Erosion could have destroyed other post holes, and others could have been missed in the excavations.

Also, if some natural feature was incorporated into the the hunting strategy, it may not have been necessary to build a complete enclosure. It has been demonstrated that a slough existed at the kill site, possibly at the time of the kill. If so, there is some chance that it was incorporated into the hunting strategy. A slippery dropoff ramp could have been constructed on one of the dune ridges. If the water was not yet frozen (or only partially frozen), the muddy slough would have impeded the bison and mired them down. Ruth Gruhn (1971: 135, 139) proposed this hypothesis for the Muhlbach kill site. This does present some problems when butchering and processing is considered, since the hunters would have to wade through uncomfortably cold and muddy water to get the job done. Hides and meat would also have become muddy and totally saturated, and possibly made processing an even more tedious undertaking. The fact that the bone beds are absent from the center of the site, and are confined to the basin perimeter would indicate that the kill and processing areas were located at the edge of a slough and not in it. It could be that the animals were killed and butchered at the edge of the slough, and that it expanded over the carcasses some time after.

If the slough was frozen over at the time of the kill, the processing difficulties could be avoided. Many of the animals would have fallen down on the ice, injuring themselves and others. They would have made relatively stationary targets, and their carcasses would be easily accessible for hide and meat processing. Ice from the slough could have been melted for boiling bones in grease rendering. The virtual absence of post holes could also be explained with this scenario, as the pound enclosure would not have been anchored into the ground, but may have only been braced into the ice itself.

It is clear that the "slough question" cannot be entirely resolved at this time. There are not many sites that are similar to the Melhagen site, so it is difficult to compare interpretations made by other analysts who face the same sort of situation. The observations made by early travellers in the Plains provide us with several possible interpretations, and any of these could be used to help explain the hunting strategies at the Melhagen site.

Historical evidence in Chapter 3 also showed that the bison were sometimes driven into deep snow drifts, where they basically became immobilized. This is another possible hunting technique that may have been used at the Melhagen site, but supporting evidence for it would be impossible to define. It should not, however, be ruled out completely.

7.3) Introduction to Bison Processing and Utilization Patterns

The butchering and processing of the bison which commenced after the kill required much cooperation and a great deal of work. Organization and priorization of tasks was necessary to process the carcasses efficiently. Hides and choice cuts of meat were taken first, while some parts were consumed on the spot.

Processing took place in the immediate vicinity of the kill, while some portions were parcelled back to the camp for more intensive preparation, distribution and storage. The less desirable parts were left behind, and constitute much of the kill site's archaeological record.

Discussion of the frequency and seasonality of the kill, the herd composition, the environmental setting, and how these aspects affected the hunting strategy make it possible to reconstruct some factors that guided the hunters' butchering and processing decisions. Historical documentation of butchering practices and some general comparative information from archaeological sites have already been reviewed and will be used in the following discussion. The Melhagen site data has been significantly affected by taphonomic, natural and cultural processes, as well as by problems with collection maintenance. In light of these factors, the reconstruction potential of past human activities at the site has been severely limited. Nevertheless, available information will be examined and some interpretations will be presented.

7.4) Butchering Patterns at the Melhagen Site

Lyman (1978: 6) noted that the end result or goal of the butchering process is the butchering unit. This can be defined on three levels:

> primary butchering units, secondary butchering units and tertiary butchering units. Primary butchering units are the gross units into which a carcass is first butchered. They may be considered analogous to contemporary "wholesale cuts."... they may include the

> hide, viscera, head, four quarters, rib cage, and vertebral column. Secondary butchering units consist of the units into which the primary units are butchered and may be considered analogous to contemporary "retail cuts." Tertiary butchering units include the brains, bone marrow, and deboned meat that is jerked or dried. That is, tertiary units are meant to encompass all possible final units resulting from butchering. It should be pointed out that consumption may occur at any step in the butchering process. In other words, primary butchering units or secondary butchering units may be cooked and eaten without further butchering. Further, discarding a butchering unit at any level may also occur (Lyman 1978: 6).

Lyman's model provides some useful terms for describing the types of butchering units, and hence the types of butchering areas found at a site. There are some problems with it, however, as these areas may be difficult to distinguish as discrete entities. In areas where primary butchering was carried out, there should be such elements as skulls, articulated legs, rib cages and articulated vertebral segments. They would be located within or very close to the actual kill location. The location of secondary butchering areas would be evidenced by disarticulated bones, possibly broken bones and bones exhibiting cut and blow marks. These areas may also include features such as cache pits which contain secondary elements. Secondary processing may occur at or near the kill site, or within a separate camp site. Following Lyman's model, tertiary units are represented by the end goals, and therefore consist largely of the soft tissues which are not preserved at archaeological sites. Thus, tertiary processing areas would be distinguished through the presence of tools required to extract bone marrow, debone and slice meat and to prepare primary units such as the hides. Tertiary areas would also be recognized by the presence of by-products such as smashed and/or burned bone fragments and associated features such as hearths, boiling pits and smudge pits. Tertiary processing may occur close to the initial processing and kill areas, but may well be conducted at a separate camp.

The summary of bison butchering observations in Chapter 3 provides a basis for the interpretation of butchering patterns at the Melhagen site. Marks which reflect these patterns of dismemberment were found on several bone elements. First, no complete skulls were found. Most had probably been smashed to obtain the brains. Because cranial bones are so fragile, few were identified, except for the auditory meatus and maxillary teeth. The articular condyle had been broken off most of the mandibles, and several condyles were scattered throughout the entire site. Clearly, mandibles were sometimes broken for marrow extraction. In these cases the bottom of the mandible had been chopped away.

Axis and atlas elements often were broken on the dorsal surface to facilitate the removal of the head from the body. Blow marks were observed on the right side of an atlas behind the odontoid process. Two cervical vertebrae had blow marks which had been directed from the rear, possibly to detach them from the thoracic segment. Almost all of the spines on the thoracic vertebrae had been broken off, either in butchering or after deposition. Several ribs had cut marks, many of which were at the articular ends. Ribs were often broken a few centimetres below the articulation with the thoracic spine. Also, cut marks were prevalent at the base of the spine on the vertebral arches. All of these observations are probably related to the removal of the strip of meat which lies along either side of the vertebral column.

Long bones generally displayed spiral fractures. Several of the Melhagen site long bones had clearly been used as chopper or fleshing tools. No obvious cut marks were observed on the articular ends, primarily because weathering and/or carnivore chewing has eroded or exfoliated them. Cutmarks were observed on metapodial shafts. These were likely produced when the hides were stripped from the legs.

Some polishing on bone fragments can be produced when they are ingested by carnivores and other ungulates (Gifford 1978: 79; 1982: 514), so it has not always been easy to distinguish these from real tools. Thus, only the most clearly identifiable bone tools have been included in the following discussion.

Pelvic bones were generally fragmented at the acetabulum, which would indicate that it was broken to remove the femur. Some of these fractures and the spiral long bone breaks could also have been produced when successive herds brought into the pound structure trampled bones left from previous kills. The general patterns seen here, however, are still consistent with those referred to in the historic and ethnographic literature. Also, it is clear that when these patterns are viewed in context with Lyman's model of butchering unit levels, all three levels of processing took place on the Melhagen site. This will be demonstrated later.

7.5) Utilization Preferences of *Bison bison* at the Melhagen Site

7.5.1) Introduction to Utilization Preferences

The discussion of the utilization preferences will be limited to the materials excavated in the 1986 and 1987 field seasons. It is not possible to include the Phenix faunal collection due to the accidental loss of provenience information some years ago (see Chapter 2). Without this information, it is impossible to draw comparisons between excavation areas.

By concentrating only on the Ramsay collection, we do not have to attempt to account for problems created by post-excavation deterioration of materials and loss of information. It is still difficult, however, to account or control for loss of information through natural and cultural processes. Dropping the Phenix materials from the remaining analysis also dramatically reduces the sample size. This certainly limits the type of analysis that can be done, and makes the results tenuous at best. It also makes it impossible to compare the Melhagen data with that from other sites. Such comparisons would be even more restricted by the fact that no two sites are excavated, recorded and analysed the same way. The quality and detail of each site's data set is related to field and lab methodologies, individual computer data-management programs and the ability of the analyst(s).

The seasonality (Chapter 6) also compounds the problem of utilization preferences. This is especially true with reference to studies of gender preferences. It was shown that the kill occurred during the fall, winter and into the late spring. Seasonal use areas cannot be distinguished across the site, and both gender groups are equally mixed. In order to properly examine the relationship between gender, element utilization and the seasonality of site usage, a number of criteria must be met. It is necessary to have good site preservation, a representative collection of all faunal materials, a statistically sufficient sample of sexed elements, and a good correlation of these sexed elements with a distinct and limited season of site occupation. The Melhagen site data does not adequately meet any of these criteria.

It would also be incorrect to ignore all the information that *is* available. Despite the limitations, there will be some attempt at this point to study faunal materials from the Ramsay collection and draw some preliminary conclusions. If nothing else, this study should at least demonstrate potential problems in dealing with sites of this nature.

7.5.2) Utilization Study Methodology

The quantification of archaeological fauna is a complex problem that has direct implications in the interpretations of hunter-gatherer utilization of animals. Grayson (1978: 28) identified three common methods of quantification:

> (1) the number of identified elements (complete or fragmentary bones or teeth) per taxon [NISP]; (2) the minimum number of individual animals per taxon represented by those identified elements [MNI]; and (3) the weight of bones per taxonomic unit. Neither abundance measures based upon the weight of bones per taxonomic unit nor the use of the number of

> identified elements per taxon...is currently in wide use.

The MNI is the basic taxonomic unit which will be used in the Melhagen site analysis, as it is most commonly used. There are problems, however, as different researchers treat the term in very different ways. The most common way of calculating the MNI of a site is to separate and count lefts and rights for paired elements, and use the side and element with the highest count to establish the MNI (ie: 12 left and 10 right mandibles = MNI of 12). Although this is standard practice, Binford (1978: 70) has confused the issue as he calculates the MNI by "dividing the observed bone count for a given identification unit by the number of bones in the anatomy of a complete animal for that unit." Thus, a collection with 12 left and 10 right mandibles would have an MNI of 11. He uses this method to recognize the fact that meat is processed in units of animal segments, and not as units of single animals. Grayson (1984: 89) noted that Binford's use of the term "MNI" for his method is essentially incorrect, as his values "have nothing to do with numbers of individuals. More appropriate is the label "minimal animal units" (MAU) which he has recently utilized (Binford (1984).

Speth (1983) calculates the MNI's from the Garnsey site in a slightly different way than Binford. He established the MNI as 35 animals from the recovery of 35 skulls. Left and right sides of each element were added together, and this total was used to determine the "Observed Elements." The %MNI is then calculated as Observed Elements / Expected Elements x 100.

This author followed the same procedure for the analysis of the Melhagen site materials, initially to attempt an overall comparison of faunal data from the two sites. Proximal or distal bone fragment portions were counted as a single element if at least 75% of that element was represented. Left and right side counts were added to determine the number of "Observed Elements" for that element. For example, 10 left and 12 right distal tibias and three complete tibias counted as 25 distal tibias. The complete tibias were also added to the proximal tibia total.

The MNI for the Ramsay collection was derived from right mandibular M3 teeth, including loose M3s and those still in the jaw. At least 50 animals are represented in the Ramsay collection. The Phenix collection has an MNI of 123 animals, which was also calculated from right mandibular M3's. This means that the Ramsay collection represents a maximum of 29% of the total sample (173 animals) excavated from the site. In addition to the complete teeth, the author found several boxes full of tooth fragments in the Phenix collection. These had once been complete teeth that Phenix had separated from the sample to calculate MNI's. They had quickly deteriorated as a result of the flooding. Although some complete specimens were retrieved from these boxes, it is suspected that the MNI count would actually have been much higher if these teeth remained in pristine condition. In any case, it is now possible to understand the extent of data loss over the past 20 years.

The results of the MNI calculations and the element counts were put into Table 7.1, which includes the entire Ramsay collection. In addition to this, the data was broken down into element counts for each excavation area. The results are in Tables 7.2 to 7.4. All tables will be discussed later.

The next step of this study was to examine the representation of bone elements against an index of their utility. This practice was initiated by Binford (1978) with his attempt to evaluate the way in which various parts of caribou and sheep were utilized by hunters. The index derived for caribou utilization is of concern to us at this point.

Binford first determined the meat, marrow and grease yield of each element in a series of indexes, which were then channelled into a single "general utility index" or GUI. Some elements, however, such as caudal vertebrae or patellas may be carried away from the site simply because they are attached to elements of higher utility. Binford therefore adjusted the GUI and developed the "modified general utility index" or MGUI (Binford 1978). These indexes do not distinguish between gender, age or nutritional state (Speth 1983: 87).

This author has serious misgivings about the indiscriminate application of this caribou index directly to bison utilization problems. Speth (1983: 88-89) expressed similar concerns, and suggested that if this index is used, the resultant explanations should be presented tentatively. Despite his own warnings, Speth explored the limits of the application of Binford's methodology to the maximum, and examined the hypothesis that hunters had avoided utilizing cows in favour of bulls at the Garnsey site. He did present a good case, but this author wonders if his results would be different had he used a MGUI derived from a bison-based utilization index.

In all fairness, a MGUI based on bison utilization had not yet been devised. Recently steps have been taken towards this by Brink and Dawe (1989). They have attempted to address serious problems raised by other researchers and critics (Jones and Metcalfe 1988; Metcalfe and Jones 1988) of Binford by developing a utility index of bison long bone elements (BUI). It is unfortunate that they have not attempted to extend this to other bone elements, as it is difficult to compare overall results with Binford's MGUI. Another problem with their bison index (Brink and Dawe 1989: 141) is that in order to utilize it fully, all long bone shaft fragments must be specifically identified by element. They had developed the index after several years of data collection at the Head-Smashed-In site in Alberta. Unfortunately they had not recorded their long bone fragment data in such a way that it could be applied to their new index. Thus they were unable to use or test it. Many of the Melhagen site long bone fragments were also not identified to their specific bone element, so there is little purpose in attempting to apply the Brink and Dawe BUI to this sample. Future researchers, however, may be able to employ this system if they collect and record their data accordingly.

7.5.3) Analysis and Results of Utilization Study

Table 7.1 shows the amount of "Observed vs. Expected" elements that were recovered in the Ramsay collections only. Had the entire Phenix collection been used against the whole site's

MNI, it is suspected that many of these elements would rate even lower. The information from this table has been plotted against Binford's MGUI in Figure 7.1.

The graph generally demonstrates a negative curvilinear relationship for most elements. Many of the elements are confined to a low to moderate frequency and most are confined to the lower end of Binford's MGUI. The shape of the curve here does not conform to Binford's (1978: 81) "gourmet curve," where hunters selected the best parts and discarded the rest. Nor does it conform strictly to the "bulk curve," where hunters "select for large quantities of parts of both high and moderate value and abandon parts of the lowest utility at rapidly accelerating rates" (Binford 1978: 81). In fact, some of the higher utility elements are found in higher frequencies than are lower utility elements (ie: cervical vertebrae vs. atlas and axis).

Mandibular M3's have the highest percentage of observed vs. expected elements. The scapula (49%), pelvis (38%), proximal radius (32%), proximal metatarsal (30%) and external-middle cuneiform (30%) all have percentage ratings of at least 30%. It is not very surprising that the scapula and pelvis were abandoned on the site at such a high rate, since they were generally stripped of their meat and left behind. They do not have a high marrow content, so are of little utility in that respect. Meat on the forelimbs of bison (and caribou) tends to be somewhat tough, since the forelimbs bear much of the bulk weight of the animal.

The occurrence of other long bone elements is also of interest. The proximal and distal radius have a low to moderate utility rating in Binford's MGUI and are found in relatively high amounts on the site. The proximal and distal humerus have a higher utility rating and are found in lower frequencies. This should not be surprising. An examination of these bones shows that they were broken at the mid-shaft to extract marrow. As was mentioned before in the gender studies, when female humeri are broken for marrow extraction, the distal end is often split lengthwise. This makes them more susceptible to erosion. Carnivores also love to chew on the articular ends of long bones, so they are often fragmented and unrecognizable after excavation.

The femur and tibia have a high utility on Binford's MGUI, and a low rate of abandonment. The distal tibia had the highest rate of abandonment of these posterior upper elements at 17%. This could be due to the fact that it is articulated with the proximal metatarsal, which had a fairly high recovery rate of 30%. It could be that tibias were broken in mid-shaft and in some cases, the meat was taken away with the upper hind limb.

The marrow found in metapodials and phalanges is comprised of a large amount of oleic acid, which has a low melting point. This marrow is reportedly more palatable and more fluid than the marrow found in the upper limbs (Speth 1983: 103). It is also the last to be affected if the animal suffers from nutritional stress. Given this, it would not be unreasonable to expect that metapodials would demonstrate a high rate of breakage compared to other long bone elements. This was not the case, however, as most of the complete long bone elements found were metapodials.

Metacarpals have a lower utility than metatarsals, so it would be reasonable to expect that metacarpals would demonstrate a high rate of abandonment on the site. In fact, proximal metatarsals have the higher representation (30%), while distal metatarsals were found in relatively equivalent percentages (13%) as the proximal metacarpal (15%) and distal metacarpal (11%). There were more complete metacarpals found than complete metatarsals, which is reasonable given their lower utility. More broken metatarsals were recovered than broken metacarpals. This would indicate that more of the metatarsals were being broken for their marrow content than were the metacarpals. Since the gender ratios for each group are fairly equivalent (Metacarpals: 64%F: 36%M; Metatarsals: 68%F:32%M), it is not really possible to suggest that one element was favoured over another on the basis of gender. It is highly possible that such gender preferences were actually practiced, but because the site was utilized throughout so many seasons, any patterns that may have existed have been obscured. Furthermore, it is unlikely that one gender would demonstrate a greater degree of nutritional stress in the winter than the other. According to Speth (1983: 104-106), the condition of both genders declines in the winter. Females may be better off going into it, but males improve more rapidly in the spring. It seems most likely that winter hunters would have to fully butcher both genders to extract the maximum amount of fatty or nutritional portions.

Each excavation area may be examined in order to study any intrasite patterns. Area A (east excavations) (Table 7.2) revealed a high number of mandibles (92%), scapulae (50% of expected MNU for this area), as well as calcanei, astraguli and some tarsal bones. The proximal and distal humerus were abandoned here more than in any other area of the site, as was the distal femur (25%). The most surprising aspect of the east side is the fact that no vertebrae were recovered, at least not in complete enough condition to be considered as one element.

This contrasts sharply with the patterns seen on the west side (Area C) (Table 7.4). Cervical vertebrae were extremely prevalent, as the MNI for this area is actually based on them and not on mandibular M3's. The axis (87%) and atlas (50%) were also abandoned at a high frequency here. During excavations, it was noted that this area revealed several concentrations of articulated cervical and thoracic vertebrae segments which had been piled on top of each other. The broken proximal ends of ribs were articulated with the thoracic vertebrae. This is a common feature at bison kill and processing sites and demonstrates how these elements were stripped of the meat and fat along the back, and how some of the ribs were taken with the brisket and the spinal column abandoned. It also reflects the small amount of disturbance here. Distal radii were also abandoned at a high rate here (63%). Anterior elements were abandoned in Area C at a higher rate than were posterior elements, except for the humerus.

The overall occurrence of bone elements in Area B (central trench) (Table 7.3) closely resembles that of the summed site data. This is to be expected as more units were excavated here than on either the east or west side. It is very possible that the apparently different patterns seen in the other two areas were produced by their smaller samples. The extreme difference in Area C, however, is not believed to be connected to the sample size. The bone bed of Area C is quite different than that of Areas A and B in that preservation was much better, and some elements were still articulated. It is possible that Area C represents more of a primary processing area, while more intensive secondary processing and butchering took place in Areas A and B. This will be examined more fully in the next section. Because the preservation varies across the site between areas of erosion and areas of deposition, it should be noted that some of these differences may be the result of taphonomic processes. Radiocarbon dates in the northern area of the site are more recent, so there is a chance that these differences are related to age of the deposits as well. Unfortunately, there is really no good way of quantifiably measuring the impact of taphonomic processes with the available data or methodologies.

7.5.4) Summary of the Utilization Study

Overall, it appears that there was moderate to high usage of almost all of the long bone elements regardless of their gender or their position on Binford's utility index. This reflects a fairly intensive use of the site, which probably lasted for several months throughout the fall and winter. It also calls into question the utility of Binford's index for bison kill sites of this nature. Over 170 animals are represented so far in the archaeological collections, and less than 25% of the site area has been excavated. Besant hunters obviously enjoyed several successful hunts here.

The lack of demonstrable gender preferences is likely due in part to the loss of data through taphonomic processes and post-excavation storage problems. It is quite possible that it reflects intensive utilization of both genders throughout the winter.

Clearly an index based on bison utilization has to be developed if archaeologists are to properly assess how bison were used by Plains hunters. Until it is further developed, much of what we infer from bison kill sites is speculative.

7.6) Distributions of Archaeological Materials and Activity Areas

When Wheat (1972: 28) studied the Olsen-Chubbuck bison kill site, he referred to the bone bed as the "Bone Bed(lam)." An equally concise or accurate term describing the remains of a kill site has not since been offered. Wheat was able to reconstruct many of the activity areas at the Olsen-Chubbuck site by carefully studying patterns of articulated bone units and clustering of specific elements. Ideally, this should be done at the Melhagen site, but no such cluster patterns (apart from the articulated vertebral units and a few piles of two or three mandibles discussed above) were found either during the excavation or in the planview records drawn in the field.

It is difficult to definitely distinguish separate and discrete kill and processing areas for three reasons. First, the entire site has not been excavated, and some of the data has been lost. Second, successive kill events and butchering activities would have been obscured and mixed by each other. The last reason is that no distinct hearth features were found that would on their own indicate intensive processing. Scattered patches of burned bone and fire cracked rock were noted, but these were representative of surface hearths and had certainly been eroded over the years.

Despite these problems, it is possible to examine the available information and attempt to define the most obvious patterns across the site. In the next section, general patterns revealed in the test pit survey on the site will be discussed. Then each individual excavation area will be examined separately to determine patterns of association.

7.6.1) Distributions From Test Pit Data

Figures 7.2 to 7.5 depict the results of the test pit survey across the site. These pits were dug at every 10 metres in a grid pattern from the datum point at 100S 100E (Figure 1.5). Each test pit was designated by its southeast corner.

Figure 7.2 shows the weight of faunal materials removed from each of the 50 cm test pits. There are several concentrations: one is on the west side along the 50E line, from 80S to 100S (Area C). Another major one is along the 110S line, between 80E and 100E (Area B). A less dense concentration lies on the east side (Area D). Much of the bone from this last area had already been removed by Phenix, so the density seen here is probably underrepresented. The northwest Phenix excavations (Area E) are not well-defined in this plot, largely because the test pits are located around the edges of its estimated location.

Figure 7.2 shows where these bone concentrations are but reveals little about their nature. Figure 7.3 defines areas with the largest bone fragments. If we can assume that areas with larger bone fragments are indicative of kill or primary processing areas, then Areas B and D stand out. Again, it is difficult to know for certain if the higher degree of bone fragmentation in the other areas is due to taphonomics or processing activities.

In Figure 7.4, concentrations of burned materials may be seen in each of the bone bed areas. This would indicate that fire had been used in some processing activities. An alternative explanation is that portions of the bone bed were burned off, either accidently in a grass fire, or intentionally to get rid of the smell of rotting meat. The fact that the burned materials were found throughout most of the tested areas may indicate a general burnoff. This is still inconclusive. In the northeast area of the site, the presence of larger bone fragments and burned bone indicates the possible existence of another bone bed. This area has been disturbed with the construction of the windmill, fencing and the dugout, and has not been properly tested.

The distribution of lithics in Figure 7.5 indicates areas where stone tools were manufactured, resharpened and/or abandoned. This density plot was derived from the number of lithic items, including tools, flakes, microflakes, cores, and debitage. Weight was not considered to be a reliable measure of the intensity of these activities, as microflakes are so light that they would be underrepresented compared to larger tools and debitage. Furthermore, the electronic scale used to measure all materials did not register a weight for the microflakes unless several were lumped together. Table 7.5 summarizes the metric and non-metric attributes of all endscrapers and sidescrapers recovered in both collections. Figure 7.23 provides photographs of these tools.

Area A shows the highest concentration of lithic items. This area also has a high faunal and burned bone concentration. This will be examined in more detail in the next section. Other areas of lithic concentration are also associated with dense bone concentrations.

7.6.2) Activity Clusters in Excavation Areas

a) Area A

Area A (Figures 7.6 to 7.9) is of particular interest because of its high lithic concentration and evidence of burning. Bone fragments here are relatively small, as they average under two grams each. This can be due to taphonomic and/or bone reduction for grease rendering. Many elements here, especially the scapulae were found fragmented *in situ*, which indicates that taphonomic processes constitute a definite factor in the degree of bone fragmentation.

Most of the faunal elements in this area are concentrated close to the burned area. This could represent a surface hearth, as no distinct fire pits were revealed in the excavations. The soil appeared to be ashy and slightly oxidized in the excavation, and was also alkaline (see Chapter 2). Lithics are especially dense in this area, and literally hundreds were excavated from these units. Most were coarse-grained quartzite flakes, and a few of these had been retouched into expedient cutting tools. A scatter of similar lithic materials was found in a depression or old blow-out just south of the site behind the dune ridge. The two flake deposits may be related in some way.

Stone tools are present with a relatively high frequency in Area A. Several cores were also recovered. Other tools included broken and complete hafted knives/spear tips (identified in Chapter 5) and projectile points. Some appeared to have been scorched by fire. A ground stone pestle (Figure 7.23: #919) was of special interest. It had been broken and discarded into the fire, and was so badly burned that it is difficult to identify its material type. Deep striations on the working end seem to indicate that it was used for a long time possibly to grind meat and berries for pemmican. A hammerstone cobble (Figure 7.23: #920) with distinctive pecking marks was also found here. This tool had probably been used to manufacture stone tools, or to smash bones into smaller fragments. The metric and non-metric attributes of these tools are summarized in Table 7.6. A broken bone flesher, a bone awl, two endscrapers, retouched flakes and a heavily patinated KRF triangular biface (Figure 7.23: #474) are all related to meat and hide processing activities.

The fact that scapulae, humeri and hind leg bone fragments were abandoned here at a high frequency is evidence that intensive tertiary processing occurred in Area A. Coarse-grained quartzite flake tool manufacturing also occurred here. The presence of broken and burned point bases and the ground stone pestle indicate that the surface hearth was used as a midden for refuse disposal. These features and characteristics are associated with tertiary processing activities.

b) Area B

The trench style of excavation (Figures 7.10 to 7.13) limits the recognition of definite activity areas. However, it is interesting that the highest bone concentrations coincide with concentrations of burned materials and lithic artifacts. These areas may be indicative of the type of processing activities seen in Area A, although the lithics here are comprised largely of KRF, Swan River chert, chalcedonies, silicified peat and fine-grained quartzites. Bone fragments vary between one and three grams on average, which again is indicative of intensive processing and/or weathering. It was noted during the excavation that the bone on the surface of the bone bed was highly weathered. Evidently the wind and sun were important taphonomic agents here.

A concentration of burned bone may be seen in Figure 7.11 near either end of the trench. Burned materials are generally scattered across this entire trench. This would seem to indicate that the site had been burned over at one time. However, the more densely concentrated burned areas have associated tool concentrations. The burned areas suggest that hearths were once present here, but have since eroded away. It is not unreasonable to suggest that they were not only the scene of secondary and tertiary processing activities, but were also focal points where the hunters warmed themselves, sharpened and manufactured tools, snacked and rested.

Area B produced some non-bison animal remains as well, including a rib and thoracic vertebrae from a mule deer, an ulna from a mustelid and a falcon claw (Walker, personal communication 1989). These elements were in definite archaeological context and are not believed to be intrusive. The presence of the mule deer cannot be fully explained. Perhaps it happened to venture too close to the pound. The mustelid and falcon were probably attracted by the large amount of meat. Since scavengers were competitors for food, they were routinely killed off.

Several points, bifaces and endscrapers were found in Area B. The projectile points include three small "Samantha" points (see Chapter 5) which were found at the west end of the trench. These were perhaps reused points that had been resharpened. A large hafted knife/spear tip made from KRF was found near the center of the trench area. This point was patinated, as were most of the KRF tools and flakes recovered in Area B and in Area A. Patination of KRF was discussed earlier in this thesis, and was shown to require specific conditions to form. These include an alkaline soil, increased temperature (which would occur at ground level against a hot sand) and time. Patches of alkaline soil lenses were revealed in the soil profiles discussed earlier. When these facts are coupled with the evidence of bone weathering, it is clear that deposits in this area have been subject to several intensive and important cultural and natural alterations.

Several possible bone tools were found here. They are denoted as "possible" because most are highly polished bone fragments. The polishing could have resulted in some cases from environmental conditions, or from ingestion by carnivores and/or ungulates. Other bone tools were definite fleshers or choppers made from metapodials and tibias.

Retouched flakes were also recovered in Area B. One blade-like tool (Figure 7.23: #3639) is especially interesting. The distal tip has been retouched and one edge of the proximal end was notched. It is not known what the intended function of this tool was. Possibly it was used to work bone or wood, or was used to scoop marrow out of long bone cavities. A graver (Figure 7.23: #5645) was found at the east end of Area B. It had been made from a broken Swan River chert projectile point base and was probably used to punch holes into hides or to engrave bone.

Tools are therefore found throughout the trench area, but as Figure 7.13 indicates, several are clustered near the burned concentrations. This pattern was also seen in Area A.

c) Area C

Since only four units were excavated here (see Figures 7.14 to 7.17) few conclusions can be drawn from such a limited sample. It is clear that this area has the highest density of faunal materials recovered on the site in the Ramsay excavations. The bones are on average larger, as most fragments weigh more than 4 grams. The unit with the bone concentration (95S 50E) also contains the most burned bone, and bone tools. More lithics are found nearby in 96S 51E. One unique item found here is a flat disc shell bead (Figure 7.23: #5943). Several teeth from the left maxilla of a domestic dog were also identified from 90S 50E (Walker, personal communication 1989). An endscraper made from KRF was found here, and at least four possible bone fleshers have been identified from this area. No diagnostic projectile points were recovered in Area C, which is surprising considering its proximity to Area D, which produced the Phenix collection. Complete and partial articulated vertebral segments were found here, evidence that Area C is a primary processing area.

d) Area D

It should be noted that in Figures 7.18 to 7.20, Phenix's coordinate system was used to map in his excavation units. All points were measured in feet from the datum point. A thorough assessment of Area D and Area E is difficult because no faunal data can be reliably included. Even the lithic data should be considered or viewed with a certain degree of caution as some units appear to lack even a single flake. This is due to the loss of provenience information. The striking feature about Area D is that there is a high concentration of flakes and microflakes (nearly 200 in a single five-foot square unit) in and around unit 110W 60S, which also produced four projectile points (atlatl tips) and one knife/spear tip. Units close to 110W 60S have a fairly dense concentration of lithics too. A number of broken bifaces, most of which are fragments of knives or atlatl points also came from this area.

"Samantha" points, or points which are smaller and highly retouched (see Chapter 5) are found around the outer edge of the tool concentration. These were perhaps used for intensive cutting during primary butchering, and were discarded or lost. A large number of other projectile points (whole and broken) representing atlatl points and knives and/or spear tips were recovered here. Only one point is known to have been recovered from the northern excavation block of Area D. Several retouched flakes were also found, as well as a couple of possible bone tools. These have probably been polished through natural processes. All but two awls resemble chopper or flesher tools made from long bones. Endscrapers were found in both blocks of Area D.

A single sherd of pottery was found in or near unit 95W 80S in the initial field tests. In a letter to Phenix, Keith Greene noted that the fragment was found in the aeolian sand above the bone bed, and in his opinion was intrusive from a later time (Phenix, personal communication 1986). The fragment is a compact body sherd and has a smooth interior and a cord-roughened exterior. The seasonality and location of the site in the sand hills would likely prohibit any on-site manufacture of pottery. It is therefore unlikely that further evidence of pottery associations will be found.

This particular bone bed appears to represent a major kill and processing area. Field drawings not included here show that several bones from this area were complete enough to be identified, and several of these were mandibles. The area had also been disturbed, as several of the planviews depict elongated stretches of bone fragments. These were probably caused by PFRA cattle making their way to the dugout on the east side of the site.

e) Area E

Again, it is difficult to assess this area (Figures 7.21 to 7.22) because so much data is missing. The field notes seem to indicate that a dense bone concentration was revealed. A high concentration of flakes and microflakes came from unit 80W 65N. Most stone tools found here were bifaces. No diagnostic projectile points were found here, which would seem to indicate that this area is associated with Area C. A bone upright feature was noted in the field drawings in the southeast corner of unit 105W 65N. It appears from these that several mandibles were jammed into the ground with at least one long bone element. A rock was at the base of the hole. No other information about this feature is available. Like Area C, it appears that this area was associated with primary and possibly secondary processing.

It should be mentioned at this point that several burned and unburned fox mandibles and foot bones were identified in the Phenix faunal collection. These have tentatively been identified as the remains of a swift fox (Walker, personal communication 1990), and at least three individuals are represented. Most of the articular ends of the metapodials had been broken off. It is possible that these were intended to be made into decorative beads, or were simply tossed into a fire as garbage. No provenience is available for these elements, but they probably came from Area D or E.

7.6.3) Summary of Activity Areas

While Phenix concentrated on the major portions of the kill and primary processing areas, the Ramsay excavations focussed more on edges of these processing areas. The test pit data would seem to indicate that there could be another bone concentration at the northern edge of the site. This likely extends past the fenced area and could not be investigated. Future testing could concentrate on the northwestern corner of the site to obtain diagnostic artifacts which are totally absent so far in this area. This is problematic in view of the radiocarbon dates from here which could suggest a more recent occupation.

Definite concentrations of burned materials seem to coincide with evidence of lithic scatters, tools and bone processing tools. The best defined processing area is in Area A, which contains evidence of a hearth and several processing tools. It is hypothesized that one major kill area existed in Area D. Most other areas seem to represent primary, secondary and/or tertiary processing areas. It is possible that they may actually be associated with additional kill areas (pounds) which have not yet been discovered. For example, Area B may be situated on the periphery of a large kill area, which could spread out towards Area D.

The large number of tools associated with hide preparation, meat processing and bone butchering indicates that much of the secondary and tertiary processing and food preparation was conducted on the site. The camp site could have been located nearby. A survey in the area (see Chapter 4) revealed at least one good candidate for a camp site about 200 metres west of the kill.

7.7) Discussion and Conclusions

Like most hunter-gatherers, the Plains Indians selected preferred body parts from the animals they killed on the basis of how these parts met the food and manufacturing needs of the group. Food-bearing elements which contained high amounts of the more palatable oleic acid were the most highly preferred and the most nutritious. In the case of bison in particular, the amount and quality of fat varied between the sexes and fluctuated throughout the year. Decisions made in the butchering and processing of bison were based on the Plains Indians' intimate knowledge of bison anatomy and nutritional states, and were designed to obtain the most desired and nutritious elements from the carcass. Such decision-making processes were recorded by early travellers and in ethnohistoric documentation. Archaeological research has produced supporting evidence of these practices, and reflects observed patterns of bison butchering and utilization.

Most attempts to quantifiably assess utilization preferences at bison kill sites have been based on Binford's (1978) caribou utilization indices. These should only be applied to bison kill site studies with caution. The application of Binford's MGUI to the Melhagen site Ramsay faunal collection produced tentative results which have to be interpreted in light of the seasonality of the site's occupation, and with a full awareness of biases produced by taphonomic processes and the small sample size.

It was seen that preferred elements at the Melhagen site were utilized intensively, while moderately preferred and non-preferred elements were also used at a relatively high rate. Butchering marks observed on bone elements reflect patterns of bison processing observed in historic records. There did not seem to be any obvious differences of utilization based on gender preferences, primarily because of the seasonality of the site. The site was occupied throughout the fall and winter, when both bison genders were nutritionally depleted and stressed. It is therefore reasonable to expect that the Besant hunters processed as many of the elements as possible to obtain the maximum available nutrition.

These results must be treated cautiously for several reasons. The first of these have already been discussed: the applicability of Binford's indices and the small sample size. Other reasons for caution can be derived from the examination of faunal, burned material and lithic distributions. It is clear that a good portion of the Ramsay sample was taken from areas which were associated with processing activities. These were generally located at the margins of the bone beds, and not in the center of the kill areas. Materials from these more marginal areas therefore reflect what was being utilized more than what was not. That does not present much of a problem in itself. However, the butchering, crushing and preparation tasks also reduce bone elements into fragments which are subject to high erosion. It is therefore difficult to measure how much of the sample was lost as a result of the processing activities themselves.

If more excavations had been conducted at the center of the kill areas instead of at their peripheries, it is likely that the faunal collection and the analysis would have produced different results. Phenix probably did excavate a large central portion of the kill area, but much of that information has been lost. It is suggested that future investigators could concentrate excavations in the southern half of Area B, and investigate the northwestern edges more thoroughly. Excavations into Area A would also produce some interesting information related to secondary and tertiary processing activities.

CHAPTER 8

Summary and Conclusions

8.1) Summary of the Melhagen Site Research

The Melhagen site is a Besant bison kill located within the Aiktow Sand Hills near Elbow, Saskatchewan. The terrain consists of stabilized, gently rolling sand dunes and is currently used as pasture land by Agriculture Canada. The site itself lies between the remnants of old partially eroded parabolic dunes and is adjacent to a windmill and dugout. It consists of at least five bone bed concentrations contained within small hillocks. Several small alkaline sloughs are scattered throughout the sand hills and indicate that the water table in this region is relatively high. The nearest present-day source of spring water is located five miles to the southeast at Deer Run Creek. The Aiktow Sand Hills are a natural refuge for a variety of game and wildfowl, and in earlier times, the bison.

The earliest European visitors to this region include Cowie, Peter Fidler, the Palliser Expedition, Henry Youle Hind and the Earl of Southesk. The area was of special interest to them primarily because of its proximity to Aiktow Creek ("the-river-that-turns") and the Elbow of the South Saskatchewan River. The uniqueness of the area probably meant that it was also significant to the Plains Indians. In historic times it marked the territorial limits of the Blackfoot tribe, was thought by the Cree to be inhabited by spirits, and was considered to be a dangerous region by the Europeans.

The environmental setting and conditions of this area have largely been responsible for both the protection and the partial erosion of the site, and have effectively altered archaeological materials from the site. The vegetation cover anchors an otherwise unstable sand hill environment, and was probably periodically disturbed by buffalo herds, grass fires and grasshoppers. Such events would have caused local episodes of deflation, erosion and redeposition of the sand. It was incidents such as this that initially buried the bone beds of the site, and erosion caused by cattle traffic and overgrazing that ultimately led to its discovery. Primary taphonomic factors such as wind and sand erosion, loadcasting, the high water table and alkaline water have affected both the bone matrix and its contents. Root growth, burrowing animals, insects, rodent and carnivore gnawing have also effectively altered the bones and teeth at this site.

The site was first discovered in the mid-1960's, and was subsequently excavated by members of the Saskatoon Archaeological Society under the direction of Tom Phenix. Excavations continued in the summer months until 1972. The recovered materials were stored in the basement of his home. A spring flood in the early 1980's destroyed much of the faunal collection and the provenience information. If this factor is combined with the other taphonomic factors, it is clear that much of the site's data has been altered or lost over the years.

Excavations in 1986 and 1987 were designed to augment the results of the Phenix excavations with new information. A number of research problem areas were identified and have been addressed in this thesis. These include the determination of: 1) the cultural affiliation of the site, 2) the frequency and seasonality of the kill event(s), and 3) interpretations concerning hunting, butchering and processing activities.

These problems were addressed through a number of analyses including radiocarbon analysis, a statistical examination of projectile point metric and non-metric attributes, a flotation study, a survey of the modern vegetation of the area, particle-size analysis, and an examination of the site's paleotopography. In addition, bison mandibles were analysed to determine the age profile of the herd and the seasonality of the kill. Bison phalanges, metapodials, and the articular ends of long bones were studied to determine the gender composition of the herd. On-site excavations were augmented by survey and testing in a one kilometre square area around the Melhagen site. Bison utilization preferences, butchering marks left on bone and activity areas were also examined.

Some difficulties were encountered in defining the site's cultural affiliation. The radiocarbon analysis showed that it was occupied during the Late Prehistoric Period. The Melhagen site had been classified as a Besant site because of its Northern Plains location and because its projectile points resemble those from other Besant sites. The definition of "Besant," however, is not very clear and has been confused with the Sonota complex by some researchers. This has occurred over the years primarily because researchers compared different site types from different regions, were using poorly defined criteria for identifying cultural affiliation, and were using different taxonomic levels or schemes of classification. A comparative examination of projectile points from a few other known Besant and Sonota sites, and a preliminary statistical analysis of the Melhagen points specifically dealt with the problem of cultural affiliation in the hope of developing more explicit definitions of diagnostics and cultural assemblages.

It was seen that projectile points from both the Besant and the Sonota site collections were made from a wide variety of lithic materials, and also displayed a wide range in size and shape. Cultural definitions of Besant and Sonota have occasionally relied on weak generalizations based on variations of these traits. The percentage of KRF in the assemblage and loosely-defined descriptions of size and shape cannot be used to identify cultural affiliation. This study suggested that habitation sites seem to contain lower amounts of KRF than do kill sites, and that the amount of KRF also varies with the distance of the site from the KRF source, and perhaps the season of occupation. It seems that the Besant hunter utilized high amounts of KRF at communal bison kill sites. It is likely that they obtained a supply of KRF through trade or travel, and then ventured onto the Plains to engage in communal hunts. The size and shape of projectile points may not be strictly related to cultural differences either. Variations may result from the raw material used to make the point, the functional history or intended use of the tool, and how much it was resharpened or reworked. On the basis of this study, the Melhagen projectile points were classified into three functionally-defined groups. The first of these may be analogous to Samantha arrow tips, or could actually represent highly reworked points. The second group is comprised of atlatl tips, and the third group of knife or spear tips.

The determination of the frequency and seasonality of the site's occupation was one of the most pivotal aspects of the analysis. It was important to know if the site represented one kill event or several, and in what season they took place. Once this problem was addressed, it was possible to interpret the remaining problem area.

It was clear that the stratigraphic information alone could not reliably indicate how many times the site had been occupied. Several horizontally separated bone beds seemed to suggest multiple occupations, but without better information it was not possible to know if these areas represented different activity areas or completely different kill events.

The faunal analysis was more informative. An age profile of the bison herd and the seasons of site occupation were developed from the analysis of bison tooth eruption patterns. It was shown that most animals were between three and eight years old at death. Foetuses, neonates, animals up to two years of age and animals over 10 years of age were totally absent in the mandible sample. Since immature loose teeth and bone elements had been excavated from the site it is clear that young animals were actually present. The fact that they were not represented in the mandibular collection may be due to their susceptibility to taphonomic processes. They may also have been removed from the site by the hunters.

The mandible study also demonstrated conclusively that several hunting events had taken place at the Melhagen site. They occurred primarily in the fall, continued throughout the winter and into the spring. Little evidence of summer kills was seen. The paucity of foetal remains may also be explained to some degree by the seasonality data, as cows would not be carrying well-developed foetuses until at least the winter.

The seasonality study was also supported by the gender analyses. Three different methods were used to examine the gender composition of the herd. These involved statistically based studies applied to the front, first phalanges, the metapodials and the distal and proximal ends of long bones. The final results showed that females dominated the herd and possibly comprised as much as 81% of the population. This particular conclusion was based on the analysis of the first front phalanges. The studies involving complete metapodials and the distal and proximal ends of long bones demonstrated that this figure probably averages between 65% and 75% females.

The discrepancies in the results of the various gender analytic techniques do not pose much of a problem. They are probably linked to the fact that the site was occupied in different seasons. In the fall, more males were integrated into the herd for the rut, and during the winter males more or less separated from the cow-calf herd. Also, the bone elements used are found in different frequencies on a site depending on the utilization preferences of the hunters, and also because of differential effects of taphonomic factors. Furthermore, the sample sizes used in each gender analysis technique were small. All results seem to support the idea that the site was occupied throughout the fall, winter and into the late spring.

Once these crucial pieces of information were presented it was possible to address the third problem: that of the activities carried out at the site. The first set of interpretations dealt with the hunting strategies used by the Besant hunters. In order to do this it was necessary to refer to aspects of the paleoenvironment and paleotopography. Since only one poorly-defined post hole had been found, it was difficult to determine what sort of hunting strategy had been used. No obvious topographic features such as steep drop offs or natural traps distinguished this area from the rest of the surrounding terrain. It is therefore likely that a pound was constructed and that the bison were driven into it. Trees growing on the site were probably used in its construction.

The examination of the paleoenvironment provided additional information that can help to interpret the hunting strategies. A flotation study was conducted with the original intention of sampling pollens and seeds from paleoflora. These results were to have been compared to the study of the present-day vegetation to see how or if the environment had changed since the site's occupation. The results were partially disappointing because the alkaline soils preserve poorly. The vast majority of seeds found in the cultural levels at this site were intrusive European weed species. The study did produce a large sample of snail shells, snail eggs and ostracods, which inhabit alkaline sloughs. These were found in the bone beds and in non-cultural samples. As such, they provide evidence that the site was once covered by a slough. Further proof of this may be seen in the stratigraphic profiles of the excavations, where definitive signs of loadcasting are clearly evident. The paleotopography of the site shows that it once sloped down 0.75 metres from the west to the east. Bones on the east side were coated with alkaline dust and had badly deteriorated.

It was not clear, however, if the slough existed at the time of the kill. If it had, it would likely have been incorporated into the hunting strategy, and utilized as a trap in conjunction with the pound. In the fall, it could have been mucky and partially frozen, and used to mire the bison down. A similar situation was seen at the Muhlbach site (Gruhn 1971). In winter months, bison would have lost their footing on the frozen surface and made easy targets. This sort of technique was observed in historic times. It is just as possible that the slough formed over the site after the kill took place, and was never a factor in the hunt at all. The presence of a surface hearth in Area A seems to support this. Perhaps the slough was present at one kill event and not at another. It is likely that this particular problem will never be fully resolved.

The last problem area also involved the examination of bison utilization, bison processing and activity areas on the site. It had originally been hoped that the gender and seasonality study would produce data that could be applied to gender utilization preferences. Such studies are based on the assumption that hunter-gatherers will utilize male and female animals differently in the different seasons because of variations in the nutritional quality (fat content) of the animals throughout the year. Some parts of the bison carcass are preferred more than others because they meet the nutritional and manufacturing needs of the hunters. It was hoped that results from the Melhagen site utilization study could be compared with Speth's (1983) study of the Garnsey site.

However, in order to conduct such a study, the site has to have been occupied in a well-defined season, site preservation has to be good and a large sample must be taken. Because the Melhagen site does not meet any of these criteria, only tentative conclusions were offered in regards to bison utilization, and no comparisons were made with the Garnsey site results.

Comparisons of elements abandoned at the Melhagen site with Binford's MGUI were made with some reservation. Serious questions have been posed by various authors regarding the application of Binford's MGUI (which was based on caribou utilization) to the utilization of bison carcasses. While new techniques are being developed, none are yet suitable for the analysis of the Melhagen site materials.

It was seen that preferred elements were utilized heavily at the Melhagen site, and that moderately preferred and lesser-preferred elements were also used. Given the seasonality of the site, this is not unexpected. Both male and female bison would be suffering similar degrees of stress in the winter. Hunters would therefore have to utilize as much of the carcass as possible to obtain the maximum amount of nutrition-bearing fat.

Butchering marks left on the bones were consistent with those found in other archaeological kill sites. It is apparent that butchering practices have changed little over time and space on the Plains. Bone densities, burned bone distributions and lithic distributions were also examined. Several concentrations of processing activities were defined. The most intensive processing seems to have been carried out on the east side, which contained a high amount of burned bone and processing tools. The faunal assemblage in this area also differs from that of the central trench. The west side of the site is also unique as it seems to represent a primary processing area, and is probably adjacent to the primary kill area. One primary kill area can be defined in the Phenix excavations in the southwest part of the site. Other kill areas may be located to the northwest, the northeast and in the same bone bed as the central trench excavations. It is clear that the Melhagen site represents more than a simple, single bison kill site.

8.2) Conclusions

In summary, the Melhagen site is a Besant bison pound kill site with associated and overlapping processing areas. It was occupied on one or more occasions from the fall, and throughout the winter to the late spring. The Besant people hunted bison, processed the meat and probably camped near the site. Many of their tools were made from Knife River flint, a material that they obtained through travel or trade to North Dakota.

A sample representing over 170 animals has been produced from excavation areas totalling less than 25% of the estimated kill and processing areas. Over 203,000 fragments and artifacts weighing over 500 kilograms have been studied and catalogued.

This thesis has made several important contributions to Plains prehistory. It has salvaged much of the unpublished information about the Melhagen site and augmented it with new data. This data was derived from a variety of sources, and has been instrumental in the interpretations that were made in regards to the problem areas discussed above. Additional issues regarding problems in the identification of cultural affiliation have been raised in the hope that others may develop better definitions of diagnostics in cultural assemblages. Theoretical and methodological concerns in regards to bison utilization are also important to the interpretations made here. It is likely that all of this information would have been lost had this research not been done.

With these interpretations in place, it will now be possible for future researchers to relate the Melhagen site to other Besant sites. Perhaps it can ultimately contribute to a better understanding of Besant origins, lifeways and relations with other Plains groups.

All of the original research goals of this project have been addressed, and most have been met. Many of the interpretations made about this site are tentative because of the small size of identifiable faunal elements. The analysis has been limited by cultural processes, butchering practices, taphonomic factors, and post-excavation storage problems. Nevertheless, it is clear that this site represents an important and clearly successful bison hunting episode in the Northern Plains.

8.3) Suggestions for Future Research

It is evident that there is a crucial need for better definitions of the Besant and Sonota culture. It is difficult to assign cultural affiliation to sites such as the Melhagen site with the present system. These definitions should be based on a quantitative and qualitative analysis of Besant and Sonota site and artifact characteristics. Initial steps in this direction were taken with the projectile point analysis, but it is by no means complete. People working on this problem should be careful not to obscure use-wear evidence from projectile points through improper handling and storage, and to collect their data in a systematic fashion. Moreover, the raw data and the methodology used should be published with the results so that others may test it and make comparisons with new information.

It is also imperative that a new bison utilization index be developed. The unfettered application of caribou-based indices is probably not a good practice and may produce spurious results.

Researchers working in the sand hills should be made aware of the limitations that such an environment imposes. Taphonomic factors can significantly alter faunal assemblages to the point where they are not suitable for some types of research. Palynological information may also be difficult to find, let alone analyze.

In regards to the Melhagen site itself, a few additional suggestions can be made. The site is protected by virtue of the fact that it is fenced off from the cattle. It is not protected from vandals. Further excavations here would have to be motivated by clearly defined research goals. It is suggested that if any excavations be done, that the northwest area be tested to obtain better cultural diagnostic information. The large bone bed in Area B should also be examined to see if it contains a primary kill. The northeast area of the site may also produce useful information regarding processing. Additional studies of the paleoenvironment could also be pursued.

Because the sand hill environment is so fragile, it is not suggested that future investigators excavate large areas. Such activity could lead to a major erosional event and the eventual destruction of the Melhagen site.

TABLE 2.1: SUMMARY OF FLORAL COVER & FREQUENCY DATA (Deck 1988)

SPECIES	MEAN COVER/ TRANSECT (CM)	RELATIVE COVER	MEAN FREQ./ TRANSECT	RELATIVE FREQUENCY	IMPORTANCE VALUE (MAX. 200)
Shrubs:					
Symphoricarpos occidentalis	440.0	31.6	91.7	22.5	54.1
Juniperus horizontalis	220.0	15.8	21.4	5.3	21.1
Rosa sp.	53.8	3.9	34.6	8.5	12.4
Elaeagnus commuatat	24.0	1.7	5.7	1.4	3.1
Arctostaphylos uva-ursi	22.0	1.6	3.4	0.8	2.4
Herbs:					
Grass spp.	388.0	27.9	66.1	16.2	44.1
Poa sp.	12.0	0.9	17.8	4.4	5.2
Agropyron trachycaulum	8.4	0.6	26.9	6.6	7.2
Agropyron trachycaulum var. glaucum	7.2	0.5	6.8	1.7	2.2
Elymus canadense	4.6	0.3	8.9	2.2	2.5
Stipa comata	4.8	0.3	10.3	2.5	2.9
Koeleria cristata	15.0	1.1	5.7	1.4	2.5
Sporolobus cryptandrus	7.0	0.5	5.6	1.4	1.9
Grass A	1.0	0.1	1.1	0.3	0.3
Grass B.	1.2	0.1	3.7	0.9	1.0
Sedge:					
Carex sp.	15.8	1.1	11.4	2.8	3.9

TABLE 2.1 (Con't): SUMMARY OF FLORAL COVER & FREQUENCY DATA(Deck 1988)

SPECIES	MEAN COVER/ TRANSECT (CM)	RELATIVE COVER	MEAN FREQ./ TRANSECT	RELATIVE FREQUENCY	IMPORTANCE VALUE (MAX. 200)
Forbs:					
Chrysopsis villosa	24.8	1.8	15.0	3.7	5.5
Artemisia ludoviciana					
var. gnaphalodes	10.6	0.8	2.5	0.6	1.4
A. frigida	31.2	2.2	17.3	4.3	6.5
A. campestris	0.4	<0.1	1.2	0.3	0.3
Solidago missouriensis	31.4	2.7	21.8	5.4	7.6
Solidago sp.	3.0	0.2	2.2	0.5	0.7
Aster laevis	10.0	0.7	2.5	0.6	1.3
Taraxacum officinale	2.4	0.2	2.2	0.5	0.7
Psoralea lanceolata	4.0	0.3	3.3	0.8	1.1
Glycyrrhiza lepidota	2.0	0.1	1.2	0.3	0.4
Descurainia sophia	12.0	0.9	7.5	1.8	2.7
Potentilla pensylvanica	0.6	<0.1	1.1	0.3	0.3
Mamillaria vivipara	1.0	0.1	2.2	0.5	0.6
Bare Ground	15.8	1.1	4.8	1.2	2.3
Litter	18.0	1.3	1.2	0.3	1.6

TABLE 2.2: OTHER PLANT SPECIES OBSERVED IN AIKTOW SAND HILLS (Not on Melhagen Site)(Deck 1988)

FAMILY	SPECIES	COMMON NAME
Betulaceae	*Betula cf. occidentalis*	Birch
Campanulaceae	*Campanula rotundifolia*	Harebell
Capparidaceae	*Cleome serrulata*	Stinking clover
Chenopodiaceae	*Salsola kali var. tenuifolia**	Russian thistle
Compositae	*Antennaria cf. parvifolia*	Everlasting
	Cirsium flodmanii	Flodman's thistle
	Helianthus petiolaris	Sunflower
Cruciferae	*Lepidium densiflorum*	Peppergrass
Gentianaceae	*Gentiana affinis*	Gentian
Gramineae	*Andropogon scoparius*	Little bluestem
	*Bromus inermis**	Brome-grass
Leguminosae	*Oxtropis splendens*	Locoweed
Salicaceae	*Salix bebbiana*	Willow

* Introduced Species

TABLE 2.3: PLANT SPECIES AT MELHAGEN SITE WITH RECORDED USES (Deck 1988)

FAMILY	SPECIES	COMMON NAME
Cactaceae	*Mamillaria vivipara*	Purple cactus
Campanulaceae	*Campanula rotundifolia*	Harebell
Caprifoliaceae	*Symphoricarpos sp.*	Wolfberry
Compositae	*Artemisia sp.*	Wormwood
	A. campestris	Plains wormwood
	A. frigida	Pasture sage
	A. ludoviciana	Prairie sage
	Aster laevis	Aster
	Solidago missouriensis	Goldenrod
Cruciferae	*Lepidium densiflorum*	Peppergrass
Elaeagnaceae	*Elaeagnus commutata*	Oleaster
Ericaceae	*Arctostaphylos uva-ursi*	Bearberry
Gramineae	*Elymus canadensis*	Wild rye
	Koeleria cristata	June grass
	Stipa comata	Feathergrass
Leguminosae	*Glycyrrhiza lepidota*	Licorice
	Oxytopis sp.	Locoweed
Pinaceae	*Juniperus sp.*	Juniper
Rosaceae	*Potentilla pensylvanica*	Cinquefoil
	Rosa sp.	Rose
Salicaceae	*Salix sp.*	Willow

TABLE 2.4: FLOTATION SAMPLES FROM THE MELHAGEN SITE

SAMPLE NO.	COORDINATES	LEVEL	EXPOSURE	DBS (cm)	REMARKS	VOL. (litres)
1	80S 120E	-	-	10 TO 20	Sterile Cultural Layer: grey paleosol Control Sample	11.5
2	88S 120E	2	2	-	SW Quad Below bone conc. Burned area; dark clay underlaid with orange sand	10
3	93S 50E	1	-	48 TO 52	NW Quad Above Bone Bed Control Sample	10
4	93S 50E	2	1	52 TO 58	NW Quad Within Bone Bed	8
5	95S 50E	2	2	50 TO 55	SW Quad Within Bone Bed	12.5
6	103S 95E	1	-	10 TO 20	SW Quad Below Sod Layer Control Sample	25
7	104S 95E	3	-	70 TO 80	SW Quad Below Bone Bed Control Sample	28
8	104S 97E	2	4	45 TO 55	SE Quad Ash Feature Lower Bone Bed	21
9	104S 98E	2	1	15 TO 25	NW Quad Top of Bone Bed Dark Paleosol mixed with sand	11
10	104S 98E	2	3	26 TO 31.5	NW Quad Bottom of Bone Bed	11
TOTAL						148

TABLE 2.5: CONTENTS OF 10 FLOTATION SAMPLES (Deck 1988)

SAMPLE NO.	COORDINATES	LEVEL	EXPOSURE	DBS (CM.)	VOLUME (LITRES)	REMARKS	SEEDS CHARRED	UNCHARRED	CHARCOAL
1	80S 120E	1	NA	10 TO 20	11.5	Control	0	2789	Trace
2	88S 120E	2	2	-	10.0	Below Bone Concentration	1	102	0.28g
3	93S 50E	1	-	48 TO 52	10.0	Control	4	81	0.01g
4	95S 50E	2	1	55 TO 58	8.0	Bone Bed	2	12	Trace
5	95S 50E	2	2	50 TO 55	12.5	Cultural	1	16	0.06g
6	103S 95E	1	-	10 TO 20	25.0	Control	0	42	Trace
7	104S 95E	3	-	70 TO 80	28.0	Control	0	0	Trace
8	104S 97E	2	4	45 TO 55	21.0	Lower Bone	1	25	0.68g
9	104S 98E	2	1	15 TO 25	11.0	Top of Bone Bed	0	673	Trace
10	104S 105E	2	3	26 TO 31.5	11.0	Mid-Bottom Bone Bed	1	36	0.09g
TOTALS					148.0		10	3776	1.12g

Total Seeds 3786
Estimated No. of Seeds 5236
Estimated No. of Seeds Per Litre 35

TABLE 2.5 (Con't): CONTENTS OF 10 FLOTATION SAMPLES

SAMPLE	SHELL GASTROPOD							BONE (GRAMS)				
NO.	TYPE 1	TYPE 2	TYPE 3	TYPE 4	CF.EGGS	FRAGS	OSTRACODA	UNBURT	BURNT/ CALCINE	LITHIC FRAGS	INSECT REMAINS	CF.RED OCHRE
1	2	3	0	0	0	Trace	0	0	0.06g	0	95	0
2	13	173	5	31	7	0.43g	2	6.71g	0.56g	12.56g	15	0
3	9	6	1	0	0	0.0g	0	41.0g	0.25g	0.04g	46	0
4	10	1	0	0	0	0.3g	1	25.93g	0.56g	0.02g	4	0
5	5	1	2	0	1	Trace	1	30.62g	3.58g	0.22g	14	1
6	2	2	0	0	0	Trace	-	0.11g	0	0	73	0
7	0	5	0	2	0	Trace	0	0.10g	0	0	1	0
8	275	102	85	0	6	1.69g	32	62.33g	50.12g	0.64g	17	0
9	171	39	25	2	0	0.11g	0	25.78g	1.09g	0.04g	51	0
10	27	10	2	1	1	Trace	17	23.19g	1.09g	0.03g	34	0
TOTALS	514	342	120	36	15	2.27g	53	215.77g	57.31g	13.55g	350	1

TABLE 2.6: COMPARISON OF REMAINS FROM SIX CULTURAL AND FOUR CONTROL SAMPLES (Deck 1988)

Materials	Cultural Samples	Control Samples
Lithic Fragments	13.51g*	0.04g
Bone: Unburnt	174.56g	41.21g
Burnt/Calcine	57.0g	0.31g
Shell: Gastropods	980	32
Fragments	2.26g	0.0g
cf. Snail Eggs	15	0
Ostracoda	53	0
Insect Remains	135	215
Charcoal	1.11g	0.01g
Seeds: **		
Charred	6	4
Uncharred	864	2912
Total Estimated Seeds ***	1421	3815
Estimated No. Seeds/Litre	19	51
Total Volume (Litres)	73.5	74.5

* Numbrs represent counts or weights (g)
** Totals represent both whole and fragmented seeds
*** Number of seeds X correction factor (or fraction weight divided by subsample weight) with subsampled fractions

TABLE 5.1: PROJECTILE POINT RAW DATA
(All measurements in mm.)

CAT.NO.	MAX. LENGTH	MAX. WIDTH	MAX. THICK	L.BODY LENGTH	R.BODY LENGTH	L.NOTCH HEIGHT	R.NOTCH HEIGHT	L.NOTCH DEPTH	R. NOTCH DEPTH	SHOULDER WIDTH
10855	* 40.9	19.4	6.8	* 30.5	* 30.4	3.8	7.2	1.0	2.2	19.2
10856	* 40.9	22.8	6.7	* 30.5	* 30.4	7.1	7.5	2.2	1.8	22.2
10857	27.4	19.8	5.0	17.8	17.8	6.3	6.6	2.0	2.2	19.8
10858	36.2	23.3	5.3	26.0	24.2	7.8	7.6	2.4	2.8	23.0
10859	* 40.9	18.5	6.0	* 30.5	* 30.4	7.0	5.8	2.4	2.7	18.3
10860	42.4	25.3	6.7	30.7	31.7	9.4	* 7.5	3.6	* 2.6	25.2
10861	50.4	22.0	6.9	41.5	41.4	7.5	7.4	2.1	2.3	21.4
10862	37.8	18.6	5.9	28.4	28.5	6.7	7.1	2.7	2.0	18.4
10863	26.8	19.0	4.9	17.2	17.4	7.0	5.4	1.5	1.8	19.0
10864	* 40.9	22.8	5.5	* 30.5	* 30.4	8.5	* 7.5	3.1	* 2.6	22.4
10865	* 40.9	23.1	5.9	* 30.5	* 30.4	6.7	8.5	2.6	3.3	22.8
10866	47.3	21.5	6.4	38.0	36.7	8.7	8.3	3.6	3.4	21.4
10867	* 40.9	25.7	5.6	* 30.5	* 30.4	9.8	9.2	4.0	4.3	24.8
10868	60.5	25.6	5.8	47.0	46.5	10.3	12.3	4.0	4.0	25.4
10869	* 40.9	23.0	6.2	* 30.5	* 30.4	8.0	7.0	3.4	2.4	23.0
10870	53.0	26.2	5.5	42.8	42.6	8.7	7.7	3.4	2.1	26.2
10871	34.5	22.0	4.3	26.7	24.7	6.9	7.2	1.8	1.3	22.3
10873	29.0	20.4	4.4	18.8	18.8	5.8	6.6	2.1	2.6	18.0
10874	* 40.9	23.0	5.9	* 30.5	* 30.4	7.4	7.2	2.4	2.9	22.6

(* Refers to cases where missing values were subsituted with means calculated from entire sample)

(** Refers to cases dropped from statistical analysis due to high incidence of missing values)

TABLE 5.1 (Cont'): PROJECTILE POINT RAW DATA

(All measurements in mm.)

CAT.NO.	MAX. BASE W.	NECK WIDTH	L. BASAL HEIGHT	R. BASAL HEIGHT	WEIGHT (GMS)
10855	16.3	14.3	9.4	9.5	3.9
10856	19.8	17.7	10.4	10.8	5.5
10857	17.8	14.7	9.5	10.2	3.0
10858	18.0	15.4	10.3	12.2	4.9
10859	15.6	12.1	11.3	9.6	3.1
10860	* 19.1	16.2	11.8	12.5	7.1
10861	19.9	16.5	10.2	9.4	7.6
10862	16.5	13.7	9.5	10.5	4.5
10863	17.6	15.5	9.3	9.6	2.6
10864	22.3	18.7	12.0	10.2	5.9
10865	20.5	16.2	10.0	12.6	9.5
10866	15.7	12.6	11.5	11.1	6.7
10867	20.0	14.9	12.7	12.7	9.8
10868	20.7	15.5	12.9	13.8	8.2
10869	19.5	16.1	11.8	9.2	6.6
10870	21.9	18.9	11.2	11.5	8.1
10871	20.7	18.6	7.3	8.3	3.4
10873	20.4	15.2	7.8	9.4	2.5
10874	15.4	13.2	11.4	10.0	7.2

(* Refers to cases where missing values were subsituted with means calculated from entire sample)

(** Refers to cases dropped from statistical analysis due to high incidence of missing values)

TABLE 5.1 (Cont'): PROJECTILE POINT RAW DATA
(All measurements in mm.)

CAT.NO.	MAX. LENGTH	MAX. WIDTH	MAX. THICK	L.BODY LENGTH	R.BODY LENGTH	L.NOTCH HEIGHT	R.NOTCH HEIGHT	L.NOTCH DEPTH	R. NOTCH DEPTH	SHOULDER WIDTH
10875	43.6	21.7	6.1	29.1	28.1	9.2	8.8	2.6	2.3	21.5
10877	62.5	23.6	6.4	51.2	50.7	11.2	9.4	3.4	3.3	23.4
10878	* 40.9	20.0	6.6	* 30.5	* 30.4	5.6	6.6	2.4	1.6	20.0
10881	72.3	27.6	6.5	60.8	60.2	8.9	10.6	3.7	3.8	26.8
10882	* 40.9	22.8	6.1	* 30.5	* 30.4	12.5	10.3	1.4	3.3	22.7
10883	* 40.9	23.3	6.0	* 30.5	* 30.4	9.5	8.7	3.2	3.0	21.4
10884	* 40.9	23.8	5.3	* 30.5	* 30.4	7.9	7.3	2.7	3.2	23.4
10885	42.6	23.0	7.6	30.7	32.9	10.3	9.3	3.5	2.6	22.8
10886	31.1	20.7	6.0	21.0	21.1	8.9	7.6	2.3	2.8	20.5
10887	52.0	24.0	6.1	39.4	40.5	9.7	6.8	2.7	2.6	24.1
10888	32.0	26.0	6.2	20.0	19.8	8.7	8.7	4.8	4.7	25.5
10889	* 40.9	26.8	5.4	* 30.5	* 30.4	7.6	8.2	3.5	3.3	26.4
10890	40.6	21.9	4.8	28.8	28.4	7.1	6.8	2.2	2.2	21.2
10891	34.4	23.0	5.5	24.8	25.3	* 7.9	6.5	* 2.6	2.4	* 21.5
10892	33.0	24.0	6.1	21.3	20.8	6.8	8.6	3.7	4.5	23.9
10893	36.4	21.9	5.6	26.6	27.7	7.3	7.1	2.2	3.2	21.3
10894	* 40.9	19.3	5.4	* 30.5	* 30.4	8.4	5.5	2.2	2.1	19.3
10895	32.1	20.0	5.7	22.7	20.5	7.1	10.0	2.2	2.3	20.0
10896	34.2	21.3	6.7	24.4	24.4	8.0	6.2	2.4	2.3	21.3
10897	40.3	19.0	5.8	29.8	30.2	7.4	8.5	2.4	2.0	18.3
10898	27.3	20.7	5.8	16.5	16.9	6.9	7.2	3.0	2.1	20.7

(* Refers to cases where missing values were subsituted with means calculated from entire sample)
(** Refers to cases dropped from statistical analysis due to high incidence of missing values)

TABLE 5.1 (Cont'): PROJECTILE POINT RAW DATA
(All measurements in mm.)

CAT.NO.	MAX. BASE W.	NECK WIDTH	L. BASAL HEIGHT	R. BASAL HEIGHT	WEIGHT (GMS)
10875	17.3	15.3	16.5	17.1	5.8
10877	22.7	21.5	13.6	12.3	9.9
10878	17.2	14.8	10.0	9.7	4.7
10881	20.7	16.4	12.3	12.0	13.7
10882	18.8	15.1	15.2	12.3	7.5
10883	17.6	13.4	12.3	11.5	7.0
10884	19.3	15.8	11.2	11.3	5.1
10885	21.7	16.7	12.5	11.6	7.1
10886	20.2	15.4	12.7	12.3	4.1
10887	23.7	19.1	12.6	11.7	7.8
10888	26.0	17.7	12.4	12.2	5.5
10889	22.5	17.5	14.5	12.0	8.5
10890	21.9	17.5	12.5	13.3	4.1
10891	23.0	17.8	* 11.2	10.9	4.9
10892	20.9	15.3	12.0	13.7	5.0
10893	18.2	14.6	11.7	8.7	4.4
10894	19.0	15.3	12.4	10.1	2.7
10895	17.6	14.6	10.9	12.5	4.1
10896	17.7	15.3	10.9	9.9	4.7
10897	16.0	12.8	10.7	11.5	4.4
10898	20.5	15.8	12.3	10.7	3.5

(* Refers to cases where missing values were subsituted with means calculated from entire sample)
(** Refers to cases dropped from statistical analysis due to high incidence of missing values)

TABLE 5.1 (Cont'): PROJECTILE POINT RAW DATA

(All measurements in mm.)

CAT.NO.	MAX. LENGTH	MAX. WIDTH	MAX. THICK	L.BODY LENGTH	R.BODY LENGTH	L.NOTCH HEIGHT	R.NOTCH HEIGHT	L.NOTCH DEPTH	R. NOTCH DEPTH	SHOULDER WIDTH
674	39.8	21.2	6.2	27.3	27.5	8.2	9.4	2.3	2.5	21.2
876	36.8	21.7	6.9	27.8	25.7	7.6	5.9	2.0	2.0	21.7
**917		21.1	6.6							
**928		21.7	6.2			7.2	5.3	1.2	1.4	21.7
1460	40.6	22.0	5.6	33.0	33.3	7.3	6.9	1.7	1.3	21.6
**2242			6.7				7.0			
2363	* 40.9	19.0	5.5	* 30.5	* 30.4	8.3	7.6	2.9	2.3	19.0
2973	64.3	24.9	6.1	52.3	54.6	10.4	6.2	2.6	2.3	24.0
3021	* 40.9	15.7	4.4	* 30.5	* 30.4	5.4	4.2	2.2	2.2	15.7
3532	* 40.9	22.5	6.3	* 30.5	* 30.4	8.0	6.9	2.8	2.3	22.5
3544	39.3	20.5	6.0	31.6	30.9	6.8	7.2	2.0	2.4	20.5
3588	31.3	17.8	4.3	21.7	22.0	7.4	8.4	2.1	2.3	17.8
3708	* 40.9	16.6	4.4	* 30.5	* 30.4	3.7	3.4	1.4	1.4	16.4
4469	* 40.9	21.3	5.4	* 30.5	* 30.4	* 7.9	4.8	1.7	2.5	21.3
4841	* 40.9	18.5	4.7	* 30.5	* 30.4	9.2	6.4	2.8	2.5	18.5
**6307		18.5	6.1				12.6		3.1	18.5
MEANS	40.9	21.8	5.8	30.5	30.4	7.9	7.5	2.6	2.6	21.5

(* Refers to cases where missing values were subsituted with means calculated from entire sample)

(** Refers to cases dropped from statistical analysis due to high incidence of missing values)

TABLE 5.1 (Cont'): PROJECTILE POINT RAW DATA
(All measurements in mm.)

CAT.NO.	MAX. BASE W.	NECK WIDTH	L. BASAL HEIGHT	R. BASAL HEIGHT	WEIGHT (GMS)
674	19.4	15.7	11.7	12.8	5.4
876	18.2	16.6	10.4	11.3	5.2
**917	19.5				4.4
**928	19.9	18.3	10.5	9.9	3.7
1460	17.8	17.0	9.0	8.9	5.0
**2242					4.6
2363	16.8	12.9	11.4	10.4	3.6
2973	21.3	17.7	13.7	11.0	10.2
3021	14.0	10.8	7.0	7.7	1.5
3532	18.7	16.4	10.4	9.1	3.5
3544	15.0	13.1	8.6	9.2	4.7
3588	16.9	13.3	10.4	10.7	2.4
3708	16.2	14.0	6.8	6.2	2.6
4469	* 19.1	14.7	6.6	6.7	3.0
4841	15.7	12.1	12.5	* 11.0	2.1
**6307		10.3	13.5	16.7	3.6
MEANS	19.1	15.5	11.2	11.0	5.4

(* Refers to cases where missing values were subsituted with means calculated from entire sample)

(** Refers to cases dropped from statistical analysis due to high incidence of missing values)

TABLE 5.2: NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	PROVENIENCE	LEVEL	INFERRED TYPE	MATERIAL TYPE	PREFORM?	PART	BODY SHAPE
10855	104W 59S	UNK	BESANT	SRC	NO	BDBS	EXCURVATE
10856	110W 55S	UNK	BESANT	KRF	NO	BDBS	EXCURVATE
10857	100W 61S	UNK	BESANT	KRF	NO	COMP	CONT/OVATE
10858	95W 82S	102.2	BESANT	SRC	NO	COMP	OVATE
10859	100W 63S	102.6	BESANT	KRF	NO	BDBS	SL.EXCURVATE
10860	109W 48S	102.4	BESANT	KRF	NO	ACM/BDTP	OVATE
10861	118W 53S	102.7	BESANT	CHL	NO	COMP	OVATE
10862	105W 55S	UNK	BESANT	KRF	NO	COMP	CONT/OVATE
10863	UNKNOWN	UNK	BESANT	CHERT	NO	COMP	TRIANG
10864	125W 55S	UNK	BESANT	KRF	NO	BDBS	OVATE
10865	107W 51S	102.5	BESANT	KRF	NO	BDBS	PAR/OVATE
10866	103W 56S	UNK	BESANT	KRF	NO	COMP	CONT/OVATE
10867	130W 55S	UNK	BESANT	KRF	NO	BDBS	OVATE
10868	116W 64S	UNK	BESANT	KRF	NO	COMP	INCURVATE
10869	115W 63S	102.65	BESANT	CHL	NO	BDBS	CONT/OVATE
10870	114W 60S	102.5	BESANT	KRF	NO	COMP	L/INC/R/OVT
10871	115W 55S	102.2	BESANT	KRF	NO	COMP	OVATE
10873	118W 58S	102.3	BESANT	KRF	NO	COMP	L/EXC/R/INC
10874	100W 65S	UNK	BESANT	KRF	NO	BDBS	OVATE
10875	122W 59S	102.4	BESANT/KNF	FSL	NO	COMP	OVATE
10877	117W 59S	UNK	BESANT	KRF	NO	COMP	L/OV/R/COV
10878	107W 62S	UNK	BESANT	CHL	NO	BDBS	OVATE
10881	107W 59S	UNK	BESANT	KRF	NO	COMP	OVATE
10882	80S 95W	UNK	BESANT	KRF	NO	ACM/BDBS	OVATE
10883	94W 23S	103.1/SURF	BESANT	KRF	NO	BDBS	OVATE

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	PROVENIENCE	LEVEL	INFERRED TYPE	MATERIAL TYPE	PREFORM?	PART	BODY SHAPE
10884	109W 54S	102.45	BESANT	KRF	NO	BDBS	L/STR/R/OV
10885	96W 83S	102.45	BESANT	CHT	NO	COMP	OVATE
10886	91W 74S	102.45	BESANT	KRF	NO	COMP	TRIANG
10887	120W 50S	UNK	BESANT	KRF	NO	COMP	OVATE
10888	123W 55S	102.6	BESANT	KRF	NO	COMP	OVATE
10889	104W 59S	UNK	BESANT	KRF	NO	BDBS	PAR/OVATE
10890	112W 63S	102.4	BESANT	BPC	NO	COMP	OVATE
10891	110W 60S	102.25	BESANT	KRF	NO	ACM/COMP	OVATE
10892	105W 55S	UNK	BESANT	KRF	NO	COMP	CONT/OVATE
10893	111W 57S	102.35	BESANT	KRF	NO	COMP	EXCURVATE
10894	114W 62S	102.55	BESANT	KRF	NO	BDBS	TRIANG
10895	119W 52S	102.75	BESANT	KRF	NO	COMP	OVATE
10896	92W 73S	102.75	BESANT	KRF	NO	COMP	OVATE
10897	111W 60S	102.1	BESANT	KRF	NO	BDBS	OVATE
10898	125W 60S	102.6	BESANT	KRF	NO	COMP	CONT/OVATE
674	90S 117E/NW	2A	BESANT	KRF	NO	COMP	CONT/OVATE
876	90S 119E/SE	2A	BESANT	SRC	NO	COMP	OVATE
917	90S 119E/SW	2A	TRIANG/BIF	SRC	YES	BDBS	EXCURVATE
928	90S 119E/SE	2A	BESANT	CHT	NO	BDBS	ABS
1460	92S 120E/NW	2A	BESANT	SRC	NO	COMP	OVATE
2242	103S 96E/SW	2A	BESANT	CHT	NO	BODY/PT.BS	CONT/OVATE
2363	103S 97E/NE	2A	BESANT	KRF	NO	BDBS	TRIANG
2843	103S 99E/SW	2B	S/N.FLAKE	KRF	NO	COMP	TRIANG
2973	103S 100E.NW	2B	BESANT	KRF	NO	COMP	OVATE
3021	104S 91E/SE	2D	BESANT/SAM	KRF	NO	BDBS	TRIANG

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	PROVENIENCE	LEVEL	INFERRED TYPE	MATERIAL TYPE	PREFORM?	PART	BODY SHAPE
3532	104S 92E/NW	2D	BESANT	SRC	NO	BDBS	BROKEN
3544	104S 92E/NW	2E	BESANT	KRF	NO	COMP	EXCURVATE
3588	104S 93E/NE	2B	BESANT	KRF	NO	COMP	TRIANG
3708	104S 93E/NW	2D	BESANT/OXB?	JSP	NO	ACM/COMP	CONT/OVATE
4469	104S 98E/NW	2C	PEL.LAKE?	SPT/HTR	NO	BDBS	TRIANG
4841	104S 100E/NE	2A	BESANT	KRF	NO	BDBS	BROKEN
6307	100S 90E/SE	ALL	BESANT/HAN	KRF	NO	BDBS	OVATE

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	BODY SYMMETRY	TRANSVERSE SEC. SHAPE	LONGITUDINAL SEC. SHAPE	L. SHOULDER SHAPE	R. SHOULDER SHAPE
10855	SYMMETRICAL	BICONVEX	BICONVEX	ROUNDED	ROUNDED
10856	SYMMETRICAL	BICONVEX	BICONVEX	OBT/ANGL	ROUNDED
10857	SYMMETRICAL	ASYM/BICON	PLANO/CONV	RT/ANGL	OBT.ANGL
10858	SYMMETRICAL	BICONVEX	PLANO/CONV	ROUNDED	OBT.ANGL
10859	ASYMMETRIC	CONVX/TRIANG	AY/CNCV/CNVX	ROUNDED	ROUNDED
10860	SYMMETRICAL	CONVX/TRIANG	AY/BICNVX	OBT/ANGL	OBT/ANGL
10861	SL.ASYMMET	BICONVEX	AY/CNCV/CNVX	ROUNDED	ROUNDED
10862	ASYMMETRIC	CONVX/TRIANG	PLANO/CONV	OBT/ANGL	OBT/ANGL
10863	SYMMETRICAL	ASYM/BICON	PLANO/CONV	ROUNDED	ROUNDED
10864	ASYMMETRIC	ASYM/BICON	PLANO/CONV	OBT/ANGL	NO SHOULDER
10865	ASYMMETRIC	BICONVEX	BIPLANO	OBT/ANGL	OBT/ANGL
10866	ASYMMETRIC	CONVX/TRIANG	BICONVEX	OBT/ANGL	OBT/ANGL
10867	ASYMMETRIC	BICONVEX	BIPLANO	OBT/ANGL	OBT/ANGL
10868	SL.ASYMMET	BICONVEX	EXCURVATE	RT/ANGL	OBT/ANGL
10869	ASYMMETRIC	BICONVEX	BIPLANO	ROUNDED	OBT/ANGL
10870	ASYMMETRIC	BICONVEX	EXCURVATE	ROUNDED	ROUNDED
10871	ASYMMETRIC	BICONVEX	BIPLANO	OBT/ANGL	ROUNDED
10873	ASYMMETRIC	BICONVEX	BIPLANO	OBT/ANGL/RN	OBT/ANGL
10874	SL.ASYMMET	BICONVEX	AY/BICNVX	ROUNDED	OBT/ANGL
10875	ASYMMETRIC	BICONVEX	AY/CNCV/CNVX	OBT/ANGL	OBT/ANGL
10877	SL.ASYMMET	BICONVEX	PLANO/CONV	ROUNDED	OBT/ANGL
10878	ASYMMETRIC	CONVX/TRIANG	AY/CNCV/CNVX	ROUNDED	RT/ANGL
10881	SL.ASYMMET	BICONVEX	BIPLANO	OBT/ANGL	ROUNDED
10882	ASYMMETRIC	BICONVEX	PLANO/CONV	OBT/ANGL	OBT/ANGL
10883	ASYMMETRIC	AY/BICONVEX	BIPLANO	ROUNDED	ROUNDED

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	BODY SYMMETRY	TRANSVERSE SEC. SHAPE	LONGITUDINAL SEC. SHAPE	L. SHOULDER SHAPE	R. SHOULDER SHAPE
10884	ASYMMETRIC	AY/BICONVEX	AY/CNCV/CNVX	ROUNDED	OBT/ANGL
10885	ASYMMETRIC	BICONVEX	BICONVEX	OBT/ANGL	OBT/ANGL
10886	SYMMETRIC	BICONVEX	BICONVEX	ROUNDED	ROUNDED
10887	SYMMETRIC	AY/BICONVEX	PLANO/CONV	OBT/ANGL	OBT/ANGL
10888	SYMMETRIC	PLANO/CONV	AY/BICNVX	OBT/ANGL	OBT/ANGL
10889	SL.ASYMMET	BICONVEX	BIPLANO	ROUNDED	OBT/ANGL
10890	ASYMMETRIC	AY/BICONVEX	AY/BIPLANO	OBT/ANGL	ROUNDED
10891	ASYMMETRIC	BICONVEX	PLANO/CONV	NO SHOULDER	OBT/ANGL
10892	ASYMMETRIC	BICONVEX	BIPLANO	RT/ANGL	ROUNDED
10893	ASYMMETRIC	AY/BICONVEX	BICONVEX	ROUNDED	OBT/ANGL
10894	ASYMMETRIC	BICONVEX	PLANO/CONV	OBT/ANGL	RT/ANGL
10895	ASYMMETRIC	PLANO/CONV	PLANO/CONV	OBT/ANGL	OBT/ANGL
10896	SL.ASYMMET	CONVX/TRIANG	AY/BICNVX	OBT/ANGL	OBT/ANGL
10897	ASYMMETRIC	CONVX/TRIANG	BICONVEX	ROUNDED	ROUNDED
10898	ASYMMETRIC	AY/BICONVEX	AY/BICNVX	ROUNDED	OBT/ANGL
674	SL.ASYMMET	PLANO/CONV	PLANO/CONV	OBT/ANGL	OBT/ANGL
876	ASYMMETRIC	BICONVEX	AY/BICNVX	OBT/ANGL	OBT/ANGL
917	ASYMMETRIC	CONVX/TRIANG	AY/EXCURV	NA	NA
928	ASYMMETRIC	BICONVEX	BICONVEX	ROUNDED	ROUNDED
1460	ASYMMETRIC	BICONVEX	PLANO/CONV	ROUNDED	ROUNDED
2242	ASYMMETRIC	PLANO/CONV	AY/BICNVX	NO SHOULDER	NO SHOULDER
2363	ASYMMETRIC	CONVX/TRIANG	PLANO/CONV	OBT/ANGL.SHR	RT/ANGL/SHR
2843	ASYMMETRIC	BIPLANO	BIPLANO	ROUNDED	RT/ANGL
2973	SYMMETRIC	BICONVEX	PLANO/CONV	OBT/ANGL	ROUNDED
3021	ASYMMETRIC	BICONVEX	AY/BICNVX	OBT/ANGL	OBT/ANGL

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	BODY SYMMETRY	TRANSVERSE SEC. SHAPE	LONGITUDINAL SEC. SHAPE	L. SHOULDER SHAPE	R. SHOULDER SHAPE
3532	ASYMMETRIC	BICONVEX	BROKEN	OBT/ANGL	OBT/ANGL
3544	ASYMMETRIC	CONVX/TRIANG	AY/BICNVX	OBT/ANGL	ROUNDED
3588	SYMMETRIC	BICONVEX	PLANO/CONV	OBT/ANGL	OBT/ANGL
3708	SYMMETRIC	BICONVEX	AY/BICNVX	OBT/ANGL	ROUNDED
4469	ASYMMETRIC	CONVX/TRIANG	AY/CNCV/CNVX	ACT/ANGL	ACT/ANGL
4841	ASYMMETRIC	CONVX/TRIANG	AY/CNCV/CNVX	OBT/ANGL	OBT/ANGL
6307	ASYMMETRIC	CONVX/TRIANG	PLANO/CONV	OBT/ANGL	ROUNDED

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	L. NOTCH ORIENTATION	R. NOTCH ORIENTATION	L. NOTCH SHAPE	R. NOTCH SHAPE	L. NOTCH MODIFICATION
10855	SIDE/SYMM	SIDE/DSKEW	ROUNDED	ROUNDED	GROUND
10856	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	DULLED
10857	SIDE/SYMM	SIDE/SYMM	ROUNDED	ANGULAR	CRUSHED
10858	SIDE/SYMM	CRN/SYMM	ROUNDED	SQUARED	GROUND
10859	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	THINNED
10860	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	DULLED
10861	SIDE/SYMM	SIDE/PSKEW	ROUNDED	SL.SQUARED	GROUND
10862	SIDE/PSKEW	SIDE/SYMM	ROUNDED	ROUNDED	CRUSH/DULL
10863	SIDE/SYMM	SIDE/PSKEW	SL.SQUARED	ROUNDED	CRUSH/DULL
10864	SIDE/PSKEW	SIDE/SYMM	ROUNDED	ROUNDED	THIN/DULL
10865	SIDE/PSKEW	SIDE/SL.PSKW	ROUNDED	ROUNDED	CRUSH/DULL
10866	COR/SL.PSKW	COR/SL.PSKW	ROUNDED	ROUNDED	CRUSH/DULL
10867	SIDE/SL.PSKW	SIDE/PSKEW	ROUNDED	ANGULAR	CRUSH/DULL
10868	SIDE/SL.DSKW	COR/PSKEW	ROUND/ANGL	ANGULAR	THIN/DULL
10869	SIDE/DSKEW	SIDE/PSKEW	SQUARED	ROUNDED	THIN/DULL
10870	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	CRUSHED
10871	SIDE/PSKEW	SIDE/SYMM	ROUNDED	ROUNDED	CRUSHED
10873	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	FLAKE/DULL
10874	COR/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	CRUSHED
10875	SIDE/SL.PSKW	2SIDE/SYMM	ROUNDED	ROUNDED	FLAKE/CRUSH
10877	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	THIN/DULL
10878	SIDE/PSKEW	SIDE/SL.PSKW	SQUARED	ANGULAR	CRUSHED
10881	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	THIN/CRUSH
10882	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	CRUSH/DULL
10883	SIDE/PSKEW	SIDE/SL.DSKW	ROUNDED	SL.SQUARED	CRUSHED

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	L. NOTCH ORIENTATION	R. NOTCH ORIENTATION	L. NOTCH SHAPE	R. NOTCH SHAPE	L. NOTCH MODIFICATION
10884	SIDE/DSKEW	SIDE/SYMM	SL.SQUARED	ROUNDED	THINNED
10885	SIDE/SYMM	SIDE/PSKEW	ROUNDED	ROUNDED	GROUND
10886	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	CRUSH/DULL
10887	SIDE/SYMM	SIDE/SL.PSKW	ROUNDED	ROUNDED	CRUSH/DULL
10888	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	THINNED
10889	SIDE/PSKEW	SIDE/PSKEW	ROUN/ANGL	ROUN/ANGL	THIN/CRUSH
10890	SIDE/SL.DSKW	SIDE/SYMM	SQUARED	SQUARED	CRUSHED
10891	SIDE/SYMM	SIDE/PSKEW	ROUNDED	ROUNDED	THIN/DULL
10892	SIDE/SL.DSKW	SIDE/SL.PSKW	ROUNDED	ROUNDED	THI/CRU/DUL
10893	SIDE/PSKEW	SIDE/PSKEW	ROUND/SQUAR	ROUNDED	THIN/DULL
10894	SIDE/SYMM	SIDE/SYMM	SQUARED	ROUNDED	CRUSHED
10895	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	CRUSHED
10896	SIDE/SL.DSKW	SIDE/SYMM	SL.ANGULAR	ROUNDED	CRUSH/DULL
10897	SIDE/PSKEW	SIDE/PSKEW	SQUARED	ANGULAR	CRUSHED
10898	SIDE/SYMM	SIDE/PSKEW	ROUNDED	ROUNDED	CRUSHED
674	SIDE/SYMM	SIDE/DSKEW	ROUNDED	ROUNDED	CRUSHED
876	SIDE/SYMM	SIDE/PSKEW	ROUNDED	ROUNDED	GROUND
917	NA	NA	NA	NA	NA
928	SIDE/PSKEW	SIDE/PSKEW	ROUNDED	ROUNDED	CRUSH/DULL
1460	COR/PSKEW	COR/PSKEW	ANGULAR	STEMMED	CRU/RET/DUL
2242	NA	SIDE/SYMM	NA	ANGULAR	NA
2363	SIDE/DSKEW	COR/PSKEW	RUNDED	RUNDED	CRUSH/DULL
2843	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	CRUSHED
2973	SIDE/SYMM	SIDE/PSKEW	ROUNDED	ROUNDED	THINNED
3021	SIDE/PSKEW	COR/PSKEW	ROUNDED	ANGULAR	CRUSH/DULL

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	L. NOTCH ORIENTATION	R. NOTCH ORIENTATION	L. NOTCH SHAPE	R. NOTCH SHAPE	L. NOTCH MODIFICATION
3532	COR/PSKEW	SIDE/SYMM	ANGULAR	ANGULAR	CRUSHED
3544	COR/PSKEW	COR/PSKEW	ROUNDED	ROUNDED	CRUSHED
3588	SIDE/DSKEW	SIDE/PSKEW	ROUNDED	ANGULAR	THINNED
3708	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	GROUN/CRUSH
4469	COR/PSKEW	COR/PSKEW	ANGULAR	ROUNDED	CRUSHED
4841	SIDE/SYMM	SIDE/SYMM	ROUNDED	ROUNDED	CRUSHED
6307	SIDE/PSKEW	COR/PSKEW	ROUNDED	ROUNDED	CRUSH/DULL

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	R. NOTCH MODIFICATION	L. BASAL EDGE SHAPE	R. BASAL EDGE SHAPE	BASE SHAPE	BASE MODIFICATION
10855	GROUND	BROKEN	ROUNDED	STRAIGHT	DULLED
10856	CHIPPED	ROUNDED	ROUNDED	CONCAVE	THINNED
10857	THIN/DULL	EXPANDING	EXPANDING	STRAIGHT	RETOUCH
10858	THIN/DULL	CONTRACTING	ROUNDED	SL.CONVEX	THINNED
10859	THINNED	EXPANDING	EXPANDING	CONVEX	RETOUCH
10860	GROUND	CONTRACTING	CONTRACTING	STRAIGHT	CRUSHED
10861	GROUND	ROUNDED	ROUNDED	STRAIGHT	DULL/THIN
10862	CRUSH/DULL	EXPANDING	EXPANDING	STRAIGHT	CRUSH/DULL
10863	THIN/DULL	ROUNDED	EXPANDING	CONCAVE	THINNED
10864	THIN/DULL	EXPANDING	PARALLEL	STRAIGHT	CRUSH/THIN
10865	GROUND	EXPANDING	EXPANDING	CONCAVE	DULL/THIN
10866	CRUSH/DULL	ROUNDED	EXPANDING	SL.CONCAVE	CRUSH/THIN
10867	CRUSHED	ROUN/EXPAN	ROUN/EXPAN	SL.CONVEX	CRUSHED
10868	CRUSH/DULL	EXPANDING	CONTRACTING	STRAIGHT	SL.THIN/DULL
10869	THIN/DULL	EXPANDING	ROUNDED	SL.CONVEX	DULL/THIN/RT
10870	CRUSHED	EXPANDING	ROUN/PARAL	SL.CONCAVE	RETOUCH
10871	GLAKED	CONTRACTING	CONTRACTING	CONVEX	RETOUCH
10873	CRUSH/DULL	EXPANDING	EXPANDING	CONVEX	BIF.FLAKED
10874	CRUSHED	CONTRACTING	CONTRACTING	CONVEX	THIN/RET
10875	FLAKE/CRUSH	EXPANDING	ROUNDED	STRAIGHT	CRUSH/THIN
10877	CRUSHED	SL.EXPAND	ROUNDED	STRAIGHT	THIN/RET
10878	CRUSHED	ROUNDED	PARALLEL	CONCAVE	CRUSH/RET
10881	THIN/CRUSH	EXPANDING	CONTRACTING	STRAIGHT	RET/CRUSH
10882	THN/FLK/DUL	EXPANDING	EXPANDING	STRAIGHT	DULL/RET
10883	CRUSH/DULL	ROUNDED	EXPANDING	STRAIGHT	CRUSH/RET

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	R. NOTCH MODIFICATION	L. BASAL EDGE SHAPE	R. BASAL EDGE SHAPE	BASE SHAPE	BASE MODIFICATION
10884	CRUSHED	CONTRACTING	ROUNDED	IRREG	RETOUCH
10885	GROUND	EXPANDING	EXPANDING	SL.CONCAVE	THINNED
10886	CRUSH/DULL	ROUNDED	EXPANDING	STRAIGHT	CRUSH/RET
10887	RETOUCH	ROUNDED	EXPANDING	SL.CONVEX	RETOUCH
10888	THINNED	ROUNDED	PARALLEL	SL.CONCAVE	CRUSH/RET
10889	THIN/CRUSH	PARALLEL	EXPANDING	CONCAVE	CRUSH/RET
10890	CRUSHED	CONTRACTING	ROUNDED	CONVEX	DULLED
10891	CRUSH/DULL	EXPANDING	EXPANDING	SL.CONCAVE	CRUSH/RET
10892	THIN/CRUSH	EXPANDING	ROUNDED	CONVEX	RETOUCHED
10893	CRUSH/DULL	EXPANDING	CONTRACTING	STRAIGHT	RETOUCH
10894	CRUSHED	EXPANDING	EXPANDING	CONCAVE	CRUSH/THIN
10895	CRUSHED	PARALLEL	CONTRACTING	STRAIGHT	CRUSHED
10896	CRUSHED	EXPANDING	ROUNDED	SL.CONCAVE	THINNED
10897	THIN/CRUSH	EXPANDING	EXPANDING	STRAIGHT	CRUSH/THIN
10898	CRUSHED	ROUND/EXPAN	ROUNDED	STRAIGHT	DULL/RET
674	CRUSHED	ROUNDED	CONTRACTING	CONVEX	THINNED
876	GROUND	ROUNDED	EXPANDING	STRAIGHT	CRUSH/DULL
917	NA	EXPANDING	EXPANDING	CONVEX	RETOUCH
928	GROUND/CRUS	EXPANDING	PARALLEL	CONCAVE	CRUSH/THIN
1460	CRU/RET/DUL	CONTRACTING	PARALLEL	STRAIGHT	CRUSH/DULL
2242	CRUSHED	NA	ROUNDED	BROKEN	RETOUCH
2363	CRUSH/DULL	ROUNDED	ROUNDED	SL.CONVEX	RETOUCH
2843	CRUSHED	ROUNDED	EXPANDING	STRAIGHT	RETOUCHED
2973	CRUSHED	ROUNDED	EXPANDING	CONCAVE	CRUSH/RET
3021	CRUSHED	ROUNDED	CONTRACTING	CONVEX	CRUSH/RET

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	R. NOTCH MODIFICATION	L. BASAL EDGE SHAPE	R. BASAL EDGE SHAPE	BASE SHAPE	BASE MODIFICATION
3532	CRUSHED	EXPANDING	EXPANDING	STRAIGHT	DULL/THIN
3544	GROUND	CONTRACTING	CONTRACTING	SL.CONVX/TAB	DULL/THIN
3588	CRUSHED	ROUNDED	EXPANDING	SL.CONVEX	RETOUCHED
3708	CRUSH/DULL	PARALLEL	EXPANDING	CONCAVE	THINNED
4469	CRUSHED	CONTRACTING	CONTRACTING	SL.CONVEX	GROUND/RET
4841	CRUSHED	EXPANDING	EXPANDING	CONCAVE	RETOUCH
6307	CRUSH/DULL	BROKEN	CONTRACTING	CONVEX	RETOUCH

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	PATINATION?	CALCIUM CARBONATE?	PRIMARY RETOUCH	SECONDARY RETOUCH	USE-WEAR DORSAL	USEWEAR VENTRAL
10855	ABS	ABS	BIFACIAL	BIF/BILAT	IND	IND
10856	ABS	ABS	BIFACIAL	BIF/BILAT	R/IMP	L
10857	ABS	ABS	DORSAL	BIF/BILAT	L/R/PERP	L/R/PERP
10858	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/SH-MD	ABS
10859	ABS	ABS	DORSAL	BIF/BILAT	L/R/SH-MD	L/R/SH-MD
10860	ABS	ABS	BIFACIAL	BIF/BILAT	R/ALL	ABS
10861	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDGES	L/R/EDGES
10862	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG/BS	BASE
10863	ABS	ABS	BIFACIAL	BIF/BILAT	ABS	L/R/EDG/BS
10864	ABS	ABS	BIFACIAL	BIF/BILAT	BASE	BASE
10865	ABS	ABS	BIFACIAL	ABS	L/R/EDG/BS	L/R/EDG/BS
10866	ABS	ABS	BIFACIAL	BIF/BIL/UNIL	L/R/EDG/TP	BS
10867	ABS	ABS	BIFACIAL	BIF/BIL/UNIL	R/BS	L/R/EDG
10868	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG	L/R/EDG
10869	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDGES	L/R/EDGES
10870	ABS	ABS	DORSAL	BIF/BILAT	L/R/EDGES	L/R/EDGES
10871	ABS	ABS	DORSAL	BIF/BILAT	L/R/EDG/BS	L/R/EDG/BS
10873	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/BS	L/R/BS
10874	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG/BS	L/R/EDG
10875	ABS	ABS	DORSAL	BIF/BILAT	L/R/EDGES	L/R/EDGES
10877	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG/BS	L/R/EDG/BS
10878	ABS	ABS	DORSAL	BIF/BILAT	L/EDG/BS/TP	ABS
10881	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG/BS	L/R/EDG/BS
10882	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG	L/R/EDG
10883	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG	L/R/EDG

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	PATINATION?	CALCIUM CARBONATE?	PRIMARY RETOUCH	SECONDARY RETOUCH	USE-WEAR DORSAL	USEWEAR VENTRAL
10884	ABS	ABS	DORSAL	BIF/BILAT	R/EDG/BS	R/EDG/BS
10885	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG	L/R/EDG
10886	ABS	ABS	BIF	BIF/BILAT	L/R/EDG	L/R/EDG
10887	ABS	ABS	DORSAL	BIF/BILAT	L/R/EDG/BS	L/R/EDG/BS
10888	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG/TP	L/R/EDG/TP
10889	ABS	ABS	BIFACIAL	BIF/BILAT	L/EDG	L/EDG
10890	ABS	ABS	DORSAL	BIF/BILAT	R/EDG/TIP	ABS
10891	ABS	ABS	BIFACIAL	BIF/BILAT	R/EDGE/BS	ABS
10892	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/PX.EDG	BS
10893	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG	L/R/EDG
10894	ABS	ABS	BIFACIAL	BIF/BILAT	R/EDG	ABS
10895	ABS	ABS	DORSAL	BIF/BILAT	L/R/EDG	L/R/EDG
10896	ABS	ABS	BIFACIAL	BIF/BILAT	R/EDG	ABS
10897	ABS	ABS	BIFACIAL	BIF/BILAT	L/R/EDG/BS	L/R/EDG/BS
10898	ABS	ABS	BIFACIAL	BIF/BILAT	L/EDG	ABS
674	ABS	ABS	BIFACIAL	BIF/BILAT	ABS	ABS
876	ABS	VENT.L/SURF	BIFACIAL	BIF/BILAT	L/R/EDG	L/R/EDG
917	ABS	VE/DOR/SURF	BIFACIAL	ABS	ABS	ABS
928	ABS	ABS	BIFACIAL	BIF/BILAT	L/EDG/BS	ABS
1460	ABS	ABS	BIFACIAL	BIF/BILAT	L/PX.EDG/BS	ABS
2242	ABS	DORS.R/SURF	BIFACIAL	BIF/BILAT	ABS	ABS
2363	DOR/VEN.SURF	R/DOR/SURF	DORSAL	BIF/BILAT	L/EDG/BS	ABS
2843	DOR/VEN.SURF	DOR/VEN.SURF	ABS	BIF/BILAT	BS/ENDSCR	ABS
2973	DOR/VEN.SURF	L/DOR.EDG	BIF	BIF/BILAT	L/R/EDG/BS	L/R/EDG/BS
3021	ABS	VENT.SURF	BIFACIAL	BIF/BILAT	R/EDG/BS	ABS

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	PATINATION?	CALCIUM CARBONATE?	PRIMARY RETOUCH	SECONDARY RETOUCH	USE-WEAR DORSAL	USEWEAR VENTRAL
3532	ABS	DOR/VEN.SURF	BIFACIAL	BIF/BILAT	ABS	ABS
3544	DOR/VEN.SURF	DOR/VEN.SURF	BIFACIAL	BIF/BILAT	L/EDG	ABS
3588	DOR/VEN.SURF	DOR/VEN.SURF	BIFACIAL	BIF/BILAT	ABS	ABS
3708	ABS	ABS	BIFACIAL	BIF/BILAT	ABS	ABS
4469	VEN.SURF	ABS	BIFACIAL	BIF/BILAT	BS/POLISH	ABS
4841	DOR/VEN.SURF	ABS	DORSAL	BIF/BILAT	ABS	ABS
6307	ABS	DOR/VEN.SURF	DORSAL	BIF/BILAT	ABS	ABS

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	REWORKING DORSAL	REWORKING VENTRAL
10855	L/R	L/R
10856	L/R	L/R
10857	L/R/EDGES	L/R/EDGES
10858	TIP	TIP
10859	L/ALL	L/R/ALL
10860	ABS	ABS
10861	L/R/SH.BLD	L/R/SH-MD
10862	SURF	SURF
10863	L	L
10864	R/BROKEN	L/BROKEN
10865	ABS	ABS
10866	R/DIST	R/DIST
10867	ABS	ABS
10868	L/R/EDG/SH	L/R/EDG/SH
10869	ABS	ABS
10870	L/SH-TP	ABS
10871	ABS	ABS
10873	ABS	ABS
10874	L/R/EDGES	L/R/EDGES
10875	2ND R/NOTCH	2ND R/NOTCH
10877	ABS	ABS
10878	ABS	ABS
10881	L/EDG/MD-TP	ABS
10882	L/EDG	ABS
10883	ABS	ABS

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	REWORKING DORSAL	REWORKING VENTRAL
10884	BASE	ABS
10885	R/TP	ABS
10886	BLDE	BLDE
10887	ABS	ABS
10888	BLADE	BLADE
10889	ABS	ABS
10890	ABS	ABS
10891	L/R/EDG	ABS
10892	PX.BLDE	PX.BLDE
10893	DIST.BLDE	DIST.BLDE
10894	ABS	R/EDG
10895	L/DIST.EDG	ABS
10896	ABS	ABS
10897	L/DIST.BLDE	ABS
10898	BLDE.SURF	BLDE.SURF
674	DIST.BLDE	ABS
876	L/EDG/R/BS	ABS
917	ABS	ABS
928	ABS	ABS
1460	ABS	ABS
2242	L/EDG	ABS
2363	ABS	ABS
2843	ABS	ABS
2973	ABS	ABS
3021	ABS	ABS

TABLE 5.2 (Con't): NON-METRIC (QUALITATIVE) PROJECTILE POINT RAW DATA

CATALOGUE NUMBER	REWORKING DORSAL	REWORKING VENTRAL
3532	ABS	ABS
3544	ABS	ABS
3588	ABS	ABS
3708	ABS	ABS
4469	ABS	ABS
4841	ABS	ABS
6307	ABS	ABS

TABLE 5.3: SUMMARY OF MELHAGEN SITE PROJECTILE POINT MEASUREMENTS

MEASUREMENT	NO. OF POINTS	MEAN	ST. DEV.	MINIMUM	MAXIMUM	RANGE
MAXIMUM LENGTH	32	40.90	11.52	26.80	72.30	45.50
MAXIMUM WIDTH	55	21.80	2.57	15.70	27.60	11.90
MAXIMUM THICKNESS	56	5.80	0.73	4.30	7.60	3.30
BODY LENGTH - LEFT	32	30.50	11.00	16.50	60.80	44.30
BODY LENGTH - RIGHT	32	30.40	11.16	16.90	60.20	43.30
NOTCH HEIGHT - LEFT	51	7.90	1.65	3.70	12.50	8.80
NOTCH HEIGTH - RIGHT	53	7.50	1.76	3.40	12.60	9.20
NOTCH DEPTH - LEFT	52	2.60	0.79	1.00	4.80	3.80
NOTCH DEPTH - RIGHT	52	2.60	0.79	1.30	4.70	3.40
SHOULDER WIDTH	53	21.50	2.54	15.70	26.80	11.10
MAXIMUM BASE WIDTH	52	19.80	2.52	14.00	26.00	12.00
NECK WIDTH	54	15.30	2.57	5.40	21.50	16.10
BASAL HEIGHT - LEFT	53	11.20	2.03	6.60	16.50	9.90
BASAL HEIGHT - RIGHT	53	11.00	2.03	6.20	17.10	10.90
WEIGHT	53	5.40	2.40	1.50	13.70	12.20

(*Calculated from complete sample, omitting missing values only)

TABLE 5.4: SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL.	% OF PHENIX COLL	% OF TOTAL COLL	NO. IN RAMSAY COLL	% OF RAMSAY COLL	% OF TOTAL COLL	TOTALS (BOTH COLL'S)	% OF TOTAL COLL'S
INFERRED POINT TYPE								
BESANT POINT	39	97.50	68.42	13	76.47	22.81	52	91.23
BESANT KNIFE	1	2.50	1.75	0	0.00	0.00	1	1.75
TRIANG/BIFACE (PREFORM)	0	0.00	0.00	1	5.88	1.75	1	1.75
SIDE NOTCHED FLAKE	0	0.00	0.00	1	5.88	1.75	1	1.75
BESANT/SAMANTHA POINT	0	0.00	0.00	1	5.88	1.75	1	1.75
PELICAN LAKE?	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.17	17	99.99	29.81	57	99.98
MATERIAL TYPE								
KRF	31	77.75	54.38	9	52.94	15.79	40	70.18
SRC	2	5.00	3.51	4	23.53	7.02	6	10.53
CHL	3	7.50	5.26	0	0.00	0.00	3	5.26
CHT	2	5.00	3.51	2	11.76	3.51	4	7.02
BPC	1	2.50	1.75	0	0.00	0.00	1	1.75
JSP	0	0.00	0.00	1	5.88	1.75	1	1.75
SPT	0	0.00	0.00	1	5.88	1.75	1	1.75
FSL	1	2.50	1.75	0	0.00	0.00	1	1.75
TOTALS	40	100.00	70.16	17	99.99	29.82	57	99.99

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL.	%OF PHENIX COLL.	%OF TOTAL COLL.	NO. IN RAMSAY COLL.	%OF RAMSAY COLL.	%OF TOTAL COLL.	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
PART								
BODY AND BASE	14	35.00	24.56	8	47.06	14.04	22	38.60
ALMOST COMP./BODY&BASE	1	2.50	1.75	0	0.00	0.00	1	1.75
COMPLETE	23	57.50	40.35	7	41.18	12.28	30	52.63
ALMOST COMP/BODY&TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
ALMOST COMP/COMPLETE	1	2.50	1.75	1	5.88	1.75	2	3.51
BODY/PART OF BASE	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.16	17	100.00	29.82	57	99.90
BODY SHAPE								
EXCURVATE	3	7.50	5.26	2	11.76	3.51	5	8.77
SLIGHTLY EXCURVATE	1	2.50	1.75	0	0.00	0.00	1	1.75
CONTRACTING/OVATE	6	15.00	10.53	3	17.65	5.26	9	15.79
OVATE	20	50.00	35.09	4	23.53	7.01	24	42.11
TRIANGULAR	3	7.50	5.26	5	29.41	8.77	8	14.04
PARALLEL-OVATE	2	5.00	3.51	0	0.00	0.00	2	3.51
INCURVATE	1	2.50	1.75	0	0.00	0.00	1	1.75
LEFT-INCURV/R-OVATE	1	2.50	1.75	0	0.00	0.00	1	1.75
LEFT-EXCURV/R-INCURV	1	2.50	1.75	0	0.00	0.00	1	1.75
LEFT-OVATE/R-CONT-OVATE	1	2.50	1.75	0	0.00	0.00	1	1.75
LEFT/STRAIGHT/R-OVATE	1	2.50	1.75	0	0.00	0.00	1	1.75
ABSENT	0	0.00	0.00	1	5.88	1.75	1	1.75
BROKEN	0	0.00	0.00	2	11.76	3.51	2	3.51
TOTALS	40	100.00	70.15	17	99.99	29.81	57	99.98

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
BODY SYMMETRY								
SYMMETRIC	9	22.50	15.79	3	17.65	5.26	12	21.05
ASYMMETRIC	24	60.00	42.11	13	76.47	22.81	37	64.91
SLIGHTLY ASYMMETRIC	7	17.50	12.28	1	5.88	1.75	8	14.04
TOTALS	40	100.00	70.18	17	100.00	29.82	52	100.00
TRANSVERSE SECTION SHAPE								
BICONVEX	22	55.00	38.60	8	47.06	14.04	30	52.63
ASYMMETRIC/BICONVEX	9	22.50	15.79	0	0.00	10.53	9	15.79
CONVEX/TRIANGULAR	7	17.50	12.28	6	35.29	3.51	13	22.81
PLANO/CONVEX	2	5.00	3.51	2	11.76	0.00	4	7.02
BIPLANO	0	0.00	0.00	1	5.89	1.75	1	1.75
TOTALS	40	100.00	70.18	17	100.00	29.83	57	100.00

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
LONGITUDINAL SECTION SHAPE								
BICONVEX	7	17.50	12.28	1	5.89	1.75	8	14.04
ASYMMETRIC/BICONVEX	5	12.50	8.77	5	29.41	8.77	10	17.53
BIPLANO	9	22.50	15.79	1	5.89	1.75	10	17.53
PLANO/CONVEX	11	27.50	19.30	6	35.29	10.53	17	29.82
ASYM/CONCAVE/CONVEX	5	12.50	8.77	2	11.76	3.51	7	12.28
EXCURVATE	2	5.00	3.51	0	0.00	0.00	2	3.51
ASYMMETRIC/BIPLANO	1	2.50	1.75	0	0.00	0.00	1	1.75
AYSMMMETRIC/EXCURVATE	0	0.00	0.00	1	5.89	1.75	1	1.75
BROKEN	0	0.00	0.00	1	5.89	1.75	1	1.75
TOTALS	40	100.00	70.17	17	100.02	29.81	57	99.96
LEFT SHOULDER SHAPE								
ROUNDED	17	42.50	29.82	3	17.65	5.26	20	35.09
OBTUSE/ANGULAR	18	45.00	31.58	10	58.82	17.54	28	49.00
RIGHT ANGLE	3	7.50	5.26	0	0.00	0.00	3	5.26
OBTUSE/ANGULAR/ROUND	1	2.50	1.75	0	0.00	0.00	1	1.75
NO SHOULDER	1	2.50	1.75	1	5.89	1.75	2	3.51
N/A	0	0.00	0.00	1	5.89	1.75	1	1.75
ACUTE ANGLE	0	0.00	0.00	1	5.89	1.75	1	1.75
OBTUSE/ANGULAR/SHARP	0	0.00	0.00	1	5.89	1.75	1	1.75
TOTALS	40	100.00	70.16	17	100.03	29.80	57	99.98

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
RIGHT SHOULDER SHAPE								
ROUNDED	13	32.50	22.81	6	35.29	10.53	19	33.33
OBTUSE/ANGULAR	24	60.00	42.11	6	35.29	10.53	30	52.63
RIGHT ANGLE	2	5.00	3.51	1	5.89	1.75	3	5.26
OBTUSE/ANGULAR/ROUND	0	0.00	0.00	0	0.00	0.00	0	0.00
NO SHOULDER	1	2.50	1.75	1	5.89	1.75	2	3.51
N/A	0	0.00	0.00	1	5.89	1.75	1	1.75
ACUTE ANGULAR	0	0.00	0.00	1	5.89	1.75	1	1.75
OBTUSE/ANGULAR/SHARP	0	0.00	0.00	0	0.00	0.00	0	0.00
RIGHT ANGULAR/SHARP	0	0.00	0.00	1	5.89	1.75	1	1.75
TOTALS	40	100.00	70.18	17	100.03	29.81	57	99.98
LEFT AND RIGHT SHOULDER SHAPE TOTALS								
ROUNDED	30	37.50	26.32	9	26.47	7.89	39	34.21
OBTUSE/ANGULAR	42	52.50	36.84	16	47.05	14.04	58	50.88
RIGHT ANGLE	5	6.25	4.39	1	2.94	0.88	6	5.26
OBTUSE/ANGULAR/ROUND	1	1.25	0.88	0	0.00	0.00	1	0.88
NO SHOULDER	2	2.50	1.75	2	5.88	1.75	4	3.51
N/A	0	0.00	0.00	2	5.88	1.75	2	1.75
ACUTE ANGULAR	0	0.00	0.00	2	5.88	1.75	2	1.75
OBTUSE/ANGULAR/SHARP	0	0.00	0.00	1	2.94	0.88	1	0.88
RIGHT ANGULAR/SHARP	0	0.00	0.00	1	2.94	0.88	1	0.88
TOTALS	80	100.00	70.18	34	99.98	29.82	114	100.00

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
LEFT NOTCH ORIENTATION								
SIDE/SYMMETRIC	15	37.50	26.32	6	35.29	10.53	21	36.84
SIDE/PROXIMAL SKEWED	15	37.50	26.32	3	17.65	5.26	18	31.58
SIDE/SLIGHT PROX SKEW	2	5.00	3.51	0	0.00	0.00	2	3.51
CORNER/SLIGHT PROX SKEW	1	2.50	1.75	0	0.00	0.00	1	1.75
SIDE/SLIGHT DIST SKEW	4	10.00	7.02	0	0.00	0.00	4	7.02
SIDE/DISTAL SKEW	2	5.00	3.51	2	11.76	3.51	4	7.02
CORNER/PROX SKEW	1	2.50	1.75	4	23.53	7.02	5	8.77
NA	0	0.00	0.00	2	11.76	3.51	2	3.51
TOTALS	40	100.00	70.18	17	99.99	29.83	57	100.00
RIGHT NOTCH ORIENTATION								
SIDE/SYMMETRIC	13	32.50	22.81	5	29.41	8.77	18	31.58
SIDE/PROXIMAL SKEWED	17	42.50	29.82	4	23.53	7.01	21	36.84
SIDE/SLIGHT PROX SKEW	4	10.00	7.02	0	0.00	0.00	4	7.02
CORNER/SLIGHT PROX SKEW	1	2.50	1.75	0	0.00	0.00	1	1.75
SIDE/SLIGHT DIST SKEW	1	2.50	1.75	0	0.00	0.00	1	1.75
SIDE/DISTAL SKEW	1	2.50	1.75	1	5.88	1.75	2	3.51
CORNER/ PROXIMAL SKEW	1	2.50	1.75	6	35.29	10.53	7	12.28
NA	0	0.00	0.00	1	5.88	1.75	1	1.75
2 SIDE/SYMMETRIC	1	2.50	1.75	0	0.00	0.00	1	1.75
CORNER SYMMETRIC	1	2.50	1.75	0	0.00	0.00	1	1.75
TOTALS	40	100.00	70.15	17	99.99	29.81	57	99.98

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
LEFT & RIGHT NOTCH ORIENTATION TOTALS								
SIDE/SYMMETRIC	28	35.00	24.56	11	32.35	9.65	39	34.21
SIDE/PROXIMAL SKEW	32	40.00	28.07	7	20.59	6.14	39	34.21
SIDE/SLIGHT PROX SKEW	6	7.50	5.26	0	0.00	0.00	6	5.26
CORNER/SLIGHT PROX SKEW	2	2.50	1.75	0	0.00	0.00	2	1.75
SIDE/SLIGHT DIST SKEW	5	6.25	4.39	0	0.00	0.00	5	4.39
SIDE/DISTAL SKEW	3	3.75	2.63	3	8.82	2.63	6	5.26
CORNER/PROXIMAL SKEW	2	2.50	1.75	10	29.41	8.77	12	10.53
N/A	0	0.00	0.00	3	8.82	2.63	3	2.63
2 SIDE/SYMMETRIC	1	1.25	0.88	0	0.00	0.00	1	0.88
CORNER/SYMMETRIC	1	1.25	0.88	0	0.00	0.00	1	0.88
TOTALS	80	100.00	70.17	34	99.99	29.82	114	100.00
LEFT NOTCH SHAPE								
ROUNDED	29	72.50	50.88	12	70.59	21.05	41	71.93
SLIGHTLY SQUARED	2	5.00	3.51	0	0.00	0.00	2	3.51
ROUND/ANGULAR	2	5.00	3.51	0	0.00	0.00	2	3.51
SQUARED	5	12.50	8.77	0	0.00	0.00	5	8.77
ROUND/SQUARED	1	2.50	1.75	0	0.00	0.00	1	1.75
SLIGHTLY ANGULAR	1	2.50	1.75	0	0.00	0.00	1	1.75
ANGULAR	0	0.00	0.00	3	17.64	5.26	3	5.26
N/A	0	0.00	0.00	2	11.76	3.51	2	3.51
TOTALS	40	100.00	70.17	17	99.99	29.82	57	99.99

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL.	%OF PHENIX COLL.	%OF TOTAL COLL.	NO. IN RAMSAY COLL.	%OF RAMSAY COLL.	%OF TOTAL COLL.	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
RIGHT NOTCH SHAPE								
ROUNDED	30	75.00	52.63	11	64.71	19.30	41	71.93
SLIGHTLY SQUARED	2	5.00	3.51	0	0.00	0.00	2	3.51
ROUND/ANGULAR	1	2.50	1.75	0	0.00	0.00	1	1.75
SQUARED	2	5.00	3.51	0	0.00	0.00	2	3.51
ROUND/SQUARED	0	0.00	0.00	0	0.00	0.00	0	0.00
SLIGHTLY ANGULAR	0	0.00	0.00	0	0.00	0.00	0	0.00
ANGULAR	5	12.50	8.77	4	23.53	7.02	9	15.79
N/A	0	0.00	0.00	1	5.88	1.75	1	1.75
STEMMED	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.17	17	100.00	29.82	57	99.99
LEFT & RIGHT NOTCH SHAPE TOTALS								
ROUNDED	59	73.75	51.75	23	67.65	20.18	82	71.93
SLIGHTLY SQUARED	4	5.00	3.51	0	0.00	0.00	4	3.51
ROUND/ANGULAR	3	3.75	2.63	0	0.00	0.00	3	2.63
SQUARED	7	8.75	6.14	0	0.00	0.00	7	6.14
ROUND/SQUARED	1	1.25	0.88	0	0.00	0.00	1	0.88
SLIGHTLY ANGULAR	1	1.25	0.88	0	0.00	0.00	1	0.88
ANGULAR	5	6.25	4.39	7	20.59	6.14	12	10.53
N/A	0	0.00	0.00	3	8.82	2.63	3	2.63
STEMMED	0	0.00	0.00	1	2.94	0.88	1	0.88
TOTALS	80	100.00	70.18	34	100.00	29.83	114	100.01

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
LEFT NOTCH MODIFICATION								
GROUND	4	10.00	7.02	1	5.88	1.75	5	8.77
DULLED	2	5.00	3.51	0	0.00	0.00	2	3.51
CRUSHED	11	27.50	19.30	6	35.29	10.53	17	29.82
CHIPPED	0	0.00	0.00	0	11.76	3.51	0	0.00
THINNED	3	7.50	5.26	2	23.53	7.01	5	8.77
CRUSHED/DULLED	9	22.50	15.79	4	0.00	0.00	13	22.81
THINNED/DULLED	6	15.00	10.53	0	0.00	0.00	6	10.53
FLAKED/DULLED	1	2.50	1.75	0	0.00	0.00	1	1.75
FLAKED/CRUSHED	1	2.50	1.75	0	0.00	0.00	1	1.75
THINNED/CRUSHED	2	5.00	3.51	0	0.00	0.00	2	3.51
THINNED/CRUSHED/DULLED	1	2.50	1.75	0	0.00	0.00	1	1.75
N/A	0	0.00	0.00	2	11.76	3.51	2	3.51
CRUSHED/RETOUCH/DULLED	0	0.00	0.00	1	5.88	1.75	1	1.75
GROUND/CRUSHED	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.17	17	99.98	29.81	57	99.98
RIGHT NOTCH MODIFICATION								
GROUND	5	12.50	8.77	2	11.76	3.51	7	12.28
DULLED	1	2.50	1.75	0	0.00	0.00	1	1.75
CRUSHED	11	27.50	19.30	9	52.94	15.79	20	35.09
CHIPPED	1	2.50	1.75	0	0.00	0.00	1	1.75
THINNED	2	5.00	3.51	0	0.00	0.00	2	3.51
CRUSHED/DULLED	8	20.00	14.04	3	17.65	5.26	11	19.30
THINNED/DULLED	5	12.50	8.77	0	0.00	0.00	5	8.77

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
RIGHT NOTCH MODIFICATION CONTINUED								
FLAKED/DULLED	0	0.00	0.00	0	0.00	0.00	0	0.00
FLAKED/CRUSHED	1	2.50	1.75	0	0.00	0.00	1	1.75
THINNED/CRUSHED	4	10.00	7.02	0	0.00	0.00	4	7.02
THINNED/CRUSHED/DULLED	0	0.00	0.00	0	0.00	0.00	0	0.00
N/A	0	0.00	0.00	1	5.88	1.75	1	1.75
CRUSHED/RETOUCH/DULLED	0	0.00	0.00	1	5.88	1.75	1	1.75
GROUND/CRUSHED	0	0.00	0.00	1	5.88	1.75	1	1.75
THINNED/FLAKED/DULLED	1	2.50	1.75	0	0.00	0.00	1	1.75
FLAKED	1	2.50	1.75	0	0.00	0.00	1	1.75
TOTALS	40	100.00	70.16	17	99.99	29.81	57	99.97
LEFT & RIGHT NOTCH MODIFICATION TOTALS								
GROUND	9	11.25	7.89	3	8.82	2.63	12	10.53
DULLED	3	3.75	2.63	0	0.00	0.00	3	2.63
CRUSHED	22	27.50	19.30	15	44.12	13.16	37	32.46
CHIPPED	1	1.25	0.88	0	0.00	0.00	1	0.88
THINNED	5	6.25	4.39	2	5.88	1.75	7	6.14
CRUSHED/DULLED	17	21.25	14.91	7	20.59	6.14	24	21.05
THINNED/DULLED	11	13.75	9.65	0	0.00	0.00	11	9.65
FLAKED/DULLED	1	1.25	0.88	0	0.00	0.00	1	0.88
FLAKED/CRUSHED	2	2.50	1.75	0	0.00	0.00	2	1.75
THINNED/CRUSHED	6	7.50	5.26	0	0.00	0.00	6	5.26
THINNED/CRUSHED/DULLED	1	1.25	0.88	0	0.00	0.00	1	0.88

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
LEFT & RIGHT NOTCH MODIFICATION TOTALS CONTINUED								
N/A	0	0.00	0.00	3	8.82	2.63	3	2.63
CRUSHED/RETOUCH/DULLED	0	0.00	0.00	2	5.88	1.75	2	1.75
GROUND/CRUSHED	0	0.00	0.00	2	5.88	1.75	2	1.75
THINNED/FLAKED/DULLED	1	1.25	0.88	0	0.00	0.00	1	0.88
FLAKED	1	1.25	0.88	0	0.00	0.00	1	0.88
TOTALS	80	100.00	70.18	34	99.99	29.81	114	100.00
LEFT BASAL EDGE SHAPE								
ROUNDED	9	22.50	15.79	7	41.18	12.28	16	28.07
EXPANDING	19	47.50	33.33	4	23.53	7.02	23	40.35
CONTRACTING	6	15.00	10.53	3	17.65	5.26	9	15.79
ROUNDED/EXPANDING	2	5.00	3.51	0	0.00	0.00	2	3.51
SLIGHTLY EXPANDING	1	2.50	1.75	0	0.00	0.00	1	1.75
PARALLEL	2	5.00	3.51	1	5.88	1.75	3	5.26
BROKEN	1	2.50	1.75	1	5.88	1.75	2	3.51
N/A	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.17	17	100.00	29.81	57	99.99

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
RIGHT BASAL EDGE SHAPE								
ROUNDED	12	30.00	21.05	2	11.76	3.51	14	24.56
EXPANDING	16	40.00	28.07	8	47.06	14.04	24	42.11
CONTRACTING	7	17.50	12.28	5	29.41	8.77	12	21.05
ROUNDED/EXPANDING	1	2.50	1.75	0	0.00	0.00	1	1.75
SLIGHTLY EXPANDING	0	0.00	0.00	0	0.00	0.00	0	0.00
PARALLEL	3	7.50	5.26	2	11.76	3.51	5	8.77
BROKEN	0	0.00	0.00	0	0.00	0.00	0	0.00
N/A	0	0.00	0.00	0	0.00	0.00	0	0.00
ROUNDED/PARALLEL	1	2.50	1.75	0	0.00	0.00	1	1.75
TOTALS	40	100.00	70.16	17	99.99	29.83	57	99.99
LEFT & RIGHT BASAL EDGE SHAPE TOTALS								
ROUNDED	21	26.25	18.42	9	26.47	7.89	30	26.32
EXPANDING	35	43.75	30.70	12	35.29	10.53	47	41.23
CONTRACTING	13	16.25	11.40	8	23.53	7.02	21	18.42
ROUNDED/EXPANDING	3	3.75	2.63	0	0.00	0.00	3	2.63
SLIGHTLY EXPANDING	1	1.25	88.00	0	0.00	0.00	1	0.88
PARALLEL	5	6.25	4.39	3	8.82	2.63	8	7.02
BROKEN	1	1.25	88.00	1	2.94	0.88	2	1.75
N/A	0	0.00	0.00	1	2.94	0.88	1	0.88
ROUNDED/PARALLEL	1	1.25	0.88	0	0.00	0.00	1	0.88
TOTALS	80	100.00	70.18	34	99.99	29.83	114	100.01

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL.	%OF PHENIX COLL.	%OF TOTAL COLL.	NO. IN RAMSAY COLL.	%OF RAMSAY COLL.	%OF TOTAL COLL.	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
BASE SHAPE								
STRAIGHT	17	42.50	29.82	4	23.53	7.02	21	36.84
CONCAVE	6	15.00	10.53	4	23.53	7.02	10	17.54
SLIGHTLY CONVEX	4	10.00	7.02	3	17.65	5.26	7	12.28
CONVEX	6	15.00	10.53	4	23.53	7.02	10	17.54
SLIGHTLY CONCAVE	6	15.00	10.53	0	0.00	0.00	6	10.53
IRREGULAR	1	2.50	1.75	0	0.00	0.00	1	1.75
SLIGHTLY CONVEX/TABBED	0	0.00	0.00	1	5.88	1.75	1	1.75
BROKEN	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.18	17	100.00	29.82	57	99.98
BASE MODIFICATION								
DULLED	2	5.00	3.51	0	0.00	0.00	2	3.51
THINNED	5	12.50	8.77	2	11.76	3.51	7	12.28
RETOUCHED	8	20.00	14.04	7	41.18	12.28	15	26.32
CRUSHED	3	7.50	5.26	0	0.00	0.00	3	5.26
DULLED/THINNED	2	5.00	3.51	2	11.76	3.51	4	7.02
CRUSHED/DULLED	1	2.50	1.75	2	11.76	3.51	3	5.26
SLIGHTLY THINNED/DULLED	1	2.50	1.75	0	0.00	0.00	1	1.75
DULLED/THINNED/RETOUCH	1	2.50	1.75	0	0.00	0.00	1	1.75
BIFACIALLY FLAKED	1	2.50	1.75	0	0.00	0.00	1	1.75
THINNED/RETOUCHED	2	5.00	3.51	0	0.00	0.00	2	3.51
CRUSHED/THINNED	5	12.50	8.77	1	5.88	1.75	6	10.53

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
BASE MODIFICATION CONTINUED								
CRUSHED/RETOUCHED	7	17.50	12.28	2	11.76	3.51	9	15.79
DULLED/RETOUCHED	2	5.00	3.51	0	0.00	0.00	2	3.51
GROUND/RETOUCHED	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.16	17	99.98	29.82	57	99.99
PATINATION								
ABSENT	40	100.00	70.18	10	58.82	17.54	50	87.72
DORSAL/VENTRAL SURFACES	0	0.00	0.00	6	35.29	10.53	6	10.53
VENTRAL SURFACE	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.18	17	99.99	29.82	57	100.00
CALCIUM CARBONATE								
ABSENT	40	100.00	70.18	6	35.29	10.53	46	80.70
VENTRAL LEFT SURFACE	0	0.00	0.00	1	5.88	3.51	1	1.75
VENTRAL/DORSAL SURFACE	0	0.00	0.00	6	35.29	10.53	6	10.53
DORSAL RIGHT SURFACE	0	0.00	0.00	2	11.76	3.51	2	3.51
VENTRAL SURFACE	0	0.00	0.00	1	5.88	1.75	1	1.75
DORSAL LEFT SURFACE	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.18	17	99.98	29.82	57	99.99

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL.	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
PRIMARY RETOUCH								
BIFACIAL	30	75.00	52.63	13	76.47	22.81	43	75.44
DORSAL	10	25.00	17.54	3	17.65	5.26	13	22.81
ABSENT	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.17	17	100.00	29.82	57	100.00
SECONDARY RETOUCH								
BIFACIAL/BILATERAL	37	92.50	64.91	16	94.12	28.07	53	92.98
BIFACIAL/BILAT/UNILAT	2	5.00	3.51	0	0.00	0.00	2	3.51
ABSENT	1	2.50	1.75	1	5.88	1.75	2	3.51
TOTALS	40	100.00	70.17	17	100.00	29.82	57	100.00
USE-WEAR: DORSAL								
INDETERMINATE	1	2.50	1.75	0	0.00	0.00	1	1.75
LEFT EDGE	2	5.00	3.51	1	5.88	1.75	3	5.26
L&R/PERPENDICULAR	1	2.50	1.75	0	0.00	0.00	1	1.75
ABSENT	1	2.50	1.75	8	47.06	14.03	9	15.79
L&R/SHOULDER-MIDSEC	2	5.00	3.51	0	0.00	0.00	2	3.51
L&R/EDGES	11	27.50	19.30	1	5.88	1.75	12	21.05
BASE	1	2.50	1.75	1	5.88	1.75	2	3.51
L&R/EDGE/BASE	10	25.00	17.54	1	5.88	1.75	11	19.30
L/R/EDGE/TIP	3	7.50	5.26	0	0.00	0.00	3	5.26

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
USE-WEAR DORSAL CONTINUED								
RIGHT EDGE/BASE	2	5.00	3.51	1	5.88	1.75	3	5.26
R/EDG/IMPACT ON TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
L/R/PROX EDGES	1	2.50	1.75	0	0.00	0.00	1	1.75
R/EDGE	3	7.50	5.26	0	0.00	0.00	3	5.26
R/EDGE/BASE	1	2.50	1.75	0	0.00	0.00	1	1.75
L/EDGE/BASE	0	0.00	0.00	2	11.76	3.51	2	3.51
L/PROX EDGE/BASE	0	0.00	0.00	1	5.88	1.75	1	1.75
BASE/AS ENDSCRAPER	0	0.00	0.00	1	5.88	1.75	1	1.75
TOTALS	40	100.00	70.14	17	99.98	29.79	57	99.96
USE-WEAR: VENTRAL								
INDETERMINATE	1	2.50	1.75	0	0.00	0.00	1	1.75
LEFT EDGE	2	5.00	3.51	0	0.00	0.00	2	3.51
L&R/PERPENDICULAR	1	2.50	1.75	0	0.00	0.00	1	1.75
ABSENT	8	20.00	14.04	15	88.24	26.32	23	40.35
L&R/SHOULDER-MIDSEC	1	2.50	1.75	0	0.00	0.00	1	1.75
L&R/EDGES	13	32.50	22.81	1	5.88	1.75	14	24.56
BASE	4	10.00	7.02	0	0.00	0.00	4	7.02
L&R/EDGE/BASE	8	20.00	14.04	1	5.88	1.75	9	15.79
L/R/EDGE/TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
R/EDGE/BASE	1	2.50	1.75	0	0.00	0.00	1	1.75
TOTALS	40	100.00	70.16	17	100.00	29.82	57	99.98

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL.	%OF PHENIX COLL	%OF TOTAL COLL	NO. IN RAMSAY COLL	%OF RAMSAY COLL	%OF TOTAL COLL	TOTALS (BOTH COLL'S)	%OF TOTAL COLL'S
REWORKING: DORSAL								
L&R EDGES	6	15.00	10.53	0	0.00	0.00	6	10.53
TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
L EDGE	4	10.00	7.02	1	5.88	1.75	5	8.77
R EDGE	0	0.00	0.00	0	0.00	0.00	0	0.00
SURFACE	1	2.50	1.75	0	0.00	0.00	1	1.75
L&R SHOULDER-MIDWAY	1	2.50	1.75	0	0.00	0.00	1	1.75
R EDGE/BROKEN	1	2.50	1.75	0	0.00	0.00	1	1.75
L EDGE/BROKEN	0	0.00	0.00	0	0.00	0.00	0	0.00
R DISTAL EDGE	1	2.50	1.75	0	0.00	0.00	1	1.75
2ND R NOTCH	1	2.50	1.75	0	0.00	0.00	1	1.75
2ND L NOTCH	0	0.00	0.00	0	0.00	0.00	0	0.00
L EDGE MID-TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
L&R EDGE AND SHOULDER	0	0.00	0.00	0	0.00	0.00	0	0.00
R EDGE AND TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
BASE	1	2.50	1.75	0	0.00	0.00	1	1.75
BLADE	2	5.00	3.51	0	0.00	0.00	2	3.51
PROXIMAL BLADE	1	2.50	1.75	0	0.00	0.00	1	1.75
DISTAL BLADE	2	5.00	3.51	1	5.88	1.75	3	5.26
L DIST EDGE	1	2.50	1.75	0	0.00	0.00	1	1.75
L DIST BLADE	1	2.50	1.75	0	0.00	0.00	1	1.75
L EDGE & R BASE	0	0.00	0.00	1	5.88	1.75	1	1.75
ABSENT	14	35.00	24.56	14	82.35	24.56	28	49.12
TOTALS	40	100.00	70.13	17	99.99	29.81	57	99.94

TABLE 5.4 (Con't) SUMMARY OF MELHAGEN SITE PROJECTILE POINT NON-METRIC DATA

ATTRIBUTE	NO. IN PHENIX COLL	% OF PHENIX COLL	% OF TOTAL COLL	NO. IN RAMSAY COLL	% OF RAMSAY COLL	% OF TOTAL COLL	TOTALS (BOTH COLL'S)	% OF TOTAL COLL'S
REWORKING: VENTRAL								
L&R EDGES	5	12.50	8.77	0	0.00	0.00	5	8.77
TIP	1	2.50	1.75	0	0.00	0.00	1	1.75
L EDGE	1	2.50	1.75	0	0.00	0.00	1	1.75
R EDGE	1	2.50	1.75	0	0.00	0.00	1	1.75
SURFACE	2	5.00	3.51	0	0.00	0.00	2	3.51
L&R SHOULDER-MIDWAY	1	2.50	1.75	0	0.00	0.00	1	1.75
R EDGE/BROKEN	0	0.00	0.00	0	0.00	0.00	0	0.00
L EDGE/BROKEN	1	2.50	1.75	0	0.00	0.00	1	1.75
R DISTAL EDGE	1	2.50	1.75	0	0.00	0.00	1	1.75
2ND R NOTCH	0	0.00	0.00	0	0.00	0.00	0	0.00
2ND L NOTCH	1	2.50	1.75	0	0.00	0.00	1	1.75
L EDGE MID-TIP	0	0.00	0.00	0	0.00	0.00	0	0.00
L&R EDGE AND SHOULDER	1	2.50	1.75	0	0.00	0.00	1	1.75
R EDGE AND TIP	0	0.00	0.00	0	0.00	0.00	0	0.00
BASE	0	0.00	0.00	0	0.00	0.00	0	0.00
BLADE	2	5.00	3.51	0	0.00	0.00	2	3.51
PROXIMAL BLADE	1	2.50	1.75	0	0.00	0.00	1	1.75
DISTAL BLADE	1	2.50	1.75	0	0.00	0.00	1	1.75
L DIST EDGE	0	0.00	0.00	0	0.00	0.00	0	0.00
L DIST BLADE	0	0.00	0.00	0	0.00	0.00	0	0.00
L EDGE & R BASE	0	0.00	0.00	0	0.00	0.00	0	0.00
ABSENT	21	52.50	36.84	17	100.00	29.82	38	66.67
TOTALS	40	100.00	70.13	17	100.00	29.82	57	99.96

TABLE 5.5: MATRIX OF ATTRIBUTE LOADINGS (THE CORRELATIONS OF ATTRIBUTES WITH THE PRINCIPAL COMPONENTS)

ATTRIBUTE	P.C. 1	P.C. 2	P.C. 3	P.C. 4	COMMUNALITY
MAX LENGTH	0.681	0.690	-0.164	-0.010	0.967
MAX WIDTH	0.878	-0.092	0.270	-0.194	0.889
MAX THICKNESS	0.502	0.092	-0.071	0.351	0.389
BODY LENGTH LEFT	0.637	0.744	-0.153	-0.039	0.984
BODY LENGTH RIGHT	0.638	0.746	-0.134	-0.022	0.982
NOTCH HEIGHT LEFT	0.744	-0.085	-0.135	0.302	0.670
NOTCH HEIGHT RIGHT	0.721	-0.307	-0.324	0.025	0.720
NOTCH DEPTH LEFT	0.713	-0.290	-0.083	-0.345	0.718
NOTCH DEPTH RIGHT	0.643	-0.407	-0.244	-0.437	0.829
SHOULDER WIDTH	0.875	-0.080	0.267	-0.162	0.870
MAX BASE WIDTH	0.618	-0.206	0.677	-0.034	0.883
NECK WIDTH	0.459	0.138	0.761	0.261	0.877
BASAL HEIGHT LEFT	0.711	-0.310	-0.191	0.449	0.840
BASAL HEIGHT RIGHT	0.641	-0.483	-0.255	0.312	0.807
WEIGHT	0.802	0.039	0.074	-0.189	0.685
EIGENVALUE	7.210	2.352	1.552	0.996	12.109
PERCENT VARIANCE ACCOUNTED FOR	48.1	15.7	10.3	6.6	80.7
CUMULATIVE PERCENT	48.1	63.7	74.1	80.7	

TABLE 5.6: WEIGHTED VALUES OF PROJECTILE POINTS (PCA)

CAT.NO.	COMPONENT1	COMPONENT2	COMPONENT3	COMPONENT4
10855	-0.99040	0.89269	-0.39958	0.37873
10856	0.03008	0.35795	0.89946	0.83205
10857	-1.20970	-0.89657	0.38011	-0.20142
10858	-0.34627	-0.94590	-1.85814	-1.42875
10859	-0.81661	0.41511	-1.32560	0.07535
10860	0.90306	-0.34983	0.17329	0.12100
10861	0.35675	1.57022	0.20015	0.20933
10862	-0.78497	0.20514	-0.77809	0.06134
10863	-1.49589	-0.58129	0.72572	0.40483
10864	0.40288	-0.16527	1.26528	-0.05788
10865	0.49314	-0.37991	0.18105	-0.98093
10866	0.48162	0.33515	-1.90226	-0.72639
10867	1.32207	-1.23732	-0.57058	-1.58568
10868	2.12978	0.26996	-1.34088	-0.93867
10869	0.27070	0.07644	0.47748	-0.39604
10870	1.24625	1.02713	1.25597	-0.57219
10871	-0.85068	0.34037	2.14523	-0.68094
10873	-1.30241	-0.76491	0.96872	-1.26048
10874	-0.03982	0.12462	-0.90409	-0.71932
10875	0.67074	-1.08844	-1.43829	2.82703
10877	2.08241	1.40718	0.33242	0.77001
10878	-0.63956	0.71119	-0.09552	0.38801
10881	2.66554	2.22349	-0.96483	-1.76557
10882	0.88953	-0.73932	-1.09151	1.97862
10883	0.45395	-0.47445	-1.11571	-0.14848
10884	0.24931	-0.28549	0.24936	-0.77742

TABLE 5.6 (Con't): WEIGHTED VALUES OF PROJECTILE POINTS (PCA)

CAT.NO.	COMPONENT1	COMPONENT2	COMPONENT3	COMPONENT4
10885	1.02841	-0.36090	0.09599	1.14587
10886	-0.18713	-1.33040	0.05139	1.19354
10887	1.14029	0.75599	1.26111	0.60570
10888	1.20730	-2.54559	1.52460	-1.69014
10889	1.19779	-0.92627	1.03837	-0.87135
10890	-0.05183	-0.39905	0.94352	0.77511
10891	-0.04899	-0.62816	1.60196	0.15221
10892	0.56316	-2.13079	0.01893	-1.22794
10893	-0.34308	-0.23759	-0.03946	-0.59865
10894	-0.55429	0.34453	0.05398	1.00753
10895	-0.47686	-1.11049	-0.66083	0.74020
10896	-0.40721	-0.25785	0.17639	0.62605
10897	-0.56558	0.11658	-1.43843	0.62159
10898	-0.57581	-1.46713	0.78228	0.55740
674	0.15800	-0.58714	-0.34263	1.02220
876	-0.28889	0.06127	0.52498	1.12916
928	-0.49797	0.87131	1.49656	1.43752
1460	-0.50426	1.09926	0.79971	0.27977
2363	-0.46829	0.09411	-1.18748	0.22026
2973	1.10854	2.27093	0.43311	1.37362
3021	-1.97551	1.22731	-1.25387	-1.54182
3532	-0.09444	0.33925	0.55119	-0.00718
3544	-0.70332	0.66133	-0.85749	-0.57472
3588	-1.16098	-0.77692	-0.82381	0.04182
3708	-2.12810	1.79938	0.40666	-1.24659
4469	-0.90150	1.08452	0.94839	-1.35762
4841	-0.64093	-0.01543	-1.57428	0.38033

TABLE 5.7: RADIOCARBON DATES FROM THE MELHAGEN SITE

SAMPLE NUMBER	EXCAVATOR	PROVENIENCE	LEVEL	RCY B.P. (ONE SIGMA)	CAL. YRS. BP INTERCEPTS	CAL. YRS. BP (ONE SIGMA)	CAL. YRS. BP (TWO SIGMA)
S-491	Phenix	100W 60S (Bed 1)	Unknown	1960 +/- 90	1921 1910 1900	2041-1821	2148-1710
S-1640	Phenix	5E 5S (Bed 4)	Unknown	1910 +/-70	1877	1946-1742	2041-1700
S-1641	Phenix	100W 65N (Bed 3)	Unknown	1710 +/- 45	1687 1674 1611	1694-1556	1770-1524
S-2855	Ramsay	100S 95E (SW)	2 (40-50 cm)	1905 +/- 110	1875	2037-1720	2145-1567
S-2856	Ramsay	95S 51E (NW)	2 (46-56 cm)	1575 +/-115	1518 1431 1421	1606-1350	1770-1290
S-2857	Ramsay	90S 120E (NW&NE)	2 (20-30 cm)	810 +/- 205	727	950-561	1173-500

ALL SAMPLES CONSIST OF BISON BONE

CALIBRATION SOURCE: STUIVER AND BECKER (1986)

TABLE 6.1: MANDIBLE AGE GROUPS AND SEASONALITIES

Mandible #	Side	Provenience	Level	Quad.	Age	Season Killed
Group 1: 0-1 Years						
Nil						
Group 2: 1-2 Years						
119	L	93S 50E	2	SW	1-2	L. Spring/E. Summer?
4438-43	L	104S 98E	2B	NW	1-2	L. Spring/E. Summer?
1730-34	L	96S 51E	2	NW	1.9-2	L. Winter/E. Spring
Group 3: 2-3 Years						
1686-88	R	95S 50E	2	NE	<2.5	Early Fall
Group 4: 3-4 Years						
9618	R	(P)90W 65N	?	?	<3.6-3.7	L.Spring/E.Summer
9782	R	(P)95W 65N	?	?	<3-4	Fall?
10919	R	(P)90W 65N	?	?	3.6	L. Summer/E. Fall
1582	R	94S 51E	2	SW	3-4	Fall
9621	R	(P)90W 65N	?	?	3-4	Late Fall/E.Winter
9615	L	(P)90W 65N	?	?	3-4	Late Fall/E.Winter
Group 5: 4-5 Years						
4526	R	104S 98E	2B	NE	4-5	L.Winter/E.Spring
16	R	93S 50E	2	SE	4-5	L.Winter/E.Spring
9156	R	(P)No Prov.	?	?	4-5	L.Winter/E.Spring
9732	R	(P)95W 25S	?	?	4-5	L.Winter/E.Spring
9616	L	(P)90W 65N	?	?	4-5	L.Winter/E.Spring
Group 6: 5-6 Years						
2345	L	103S 96E	2C	NE	5-6	Fall
4901	R	104S 100E	2A	SW	5-6	Fall
4795	L	104S 100E	2A	SE	5-6	Fall
9783	L	(P)95W 65N	?	?	5-6	Fall
9658	R	(P)100W 65N	?	?	5-6	Fall
9638	R	(P)105W 65N	?	?	5-6	Fall
9147	R	(P)No Prov.	?	?	5-6	Fall
6737	R	100S 85E	All	SE	5-6	Fall

TABLE 6.1 (Cont'd): MANDIBLE AGE GROUPS AND SEASONALITIES

Mandible #	Side	Provenience	Level	Quad.	Age	Season Killed
Group 6: 5-6 Years (Con't)						
266	R	94S 51E	2	SW	5-6	L.Fall/E.Winter
5463	R	104S 104E	2B	SW	5-6	L.Fall/E.Winter
9619	R	(P)90W 65N	?	?	5-6	L.Fall/E.Winter
6654	L	100S 50E	All	SE	5-6	Unknown
10918	L	90W 65N	?	?	5-6	Unknown
Group 7: 7-8 Years						
10920-21	R	(P)90W 65N	?	?	6.6-6.7	Fall
9639	L	(P)105W 65N	?	?	6-7	L.Fall/E.Winter
9765	R	(P)95W 65N	?	?	6-7	L.Fall/E.Winter
6733	R	100S 85E	All	SE	6-7	L.Fall/E.Winter
9808	R	(P) 95W 65N	?	?	6-7	L.Fall/E.Winter
48	L	93S 50E	2	SE	6-7	L.Winter/E.Spring
1749	L	96S 51E	2	SW	6-7	L.Winter/E.Spring
6656	R	100S 50E	All	SE	6-7	L.Winter/E.Spring
9617	L	90W 65N	?	?	6-7	L.Winter/E.Spring
9141	L	(P)No Prov.	?	?	6-7	Unknown
9142	L	(P)No Prov.	?	?	6-7	Unknown
9153	R	(P)No Prov.	?	?	6-7	Unknown
10072	L	(P)100W 60S	?	?	6-7	Unknown
Group 8: 7-8 Years						
9152	R	(P)No Prov.	?	?	7-8	Unknown
9766	R	(P)No Prov.	?	?	7-8	Unknown
9767	R	(P)No Prov.	?	?	7-8	Unknown
Group 9: 8-9 Years						
118	R	93S 50E	2	SW	8-9	Unknown
9764	R	(P)95W 65N	?	?	8-9	Unknown
9763	L	(P)95W 65N	?	?	8-9	Unknown
Group 10: 9-10 Years						
9620	R	(P)90W 65N	?	?	9-10	Unknown
9734	R	(P)95W 25S	?	?	9-10	Unknown

TABLE 6.2: MELHAGEN FRONT FIRST PHALANGES (Peach 1990b)

Cat. No.	Provenience	Level	Quad.	Side	Greatest Length	Distal Height	Length	Index	Gender
593	89S 120E	2	NE	LMRL*	65.6	24.1	63.6	28.59	F
740	90S 118E	2	NE	LLRM*	65.0	24.3	62.5	28.71	F
986	91S 120E	2	NW	LLRM	68.6	25.6	65.3	30.47	F
1142	91S 120E	2	NW	LMRL	69.0	28.8	65.1	32.49	M
1923	101S 95E	2A	SW	LMRL	63.0	23.2	60.8	27.57	F
2120	103S 95E	2B	SW	LLRM	68.9	24.6	66.0	29.88	F
2185	103S 95E	2B	NE	LMRL	71.0	25.5	69.6	30.40	F
2634	103S 98E	2B	NE	LMRL	68.7	25.8	66.5	30.28	F
2995	104S 91E	2B	SE	LLRM	63.0	25.1	60.6	28.67	F
3047	104S 91E	2B	NW	LLRM	64.1	24.2	62.5	28.19	F
3192	104S 91E	2B	NE	LMRL	64.3	24.2	63.0	28.15	F
3360	104S 92E	2C	SE	LMRL	74.3	25.9	72.0	31.63	M
3667	104S 92E	2D	SE	LMRL	63.4	20.5	61.0	26.24	F
6140	85S 125E	ALL	SE	LMRL	69.7	22.8	67.7	28.81	F
6369	90S 120E	ALL	SE	LMRL	73.7	28.8	69.3	33.70	M
6790	100S 85E	ALL	SE	LLRM	60.9	23.2	59.3	26.92	F
7019	99S 95E	2A	NE	LLRM	71.9	25.9	67.9	31.59	M
7325	95S 53E	ALL	SE	LMRL	62.2	23.9	60.8	27.54	F
7365	90S 121E	ALL	NW	LMRL	65.3	22.6	62.4	27.97	F
7575	(P)UNKNOWN	UNKNOWN	NA	LLRM	69.9	27.3	65.7	31.96	M

*LMRL = LEFT MEDIAL, RIGHT LATERAL
*LLRM = LEFT LATERAL, RIGHT MEDIAL

TABLE 6.2 (CON'T) :MELHAGEN FRONT FIRST PHALANGES (Peach 1990b)

Cat. No.	Provenience	Level	Quad.	Side	Greatest Length	Distal Height	Length	Index	Gender
7893	(P)UNKNOWN	UNKNOWN	NA	LLRM	64.0	24.0	63.6	27.70	F
9413	(P)100W 65S	UNKNOWN	NA	LMRL	65.2	27.4	64.0	30.07	F
9788	(P)UNKNOWN	UNKNOWN	NA	LMRL	61.8	23.2	60.8	26.95	F
10265	(P)UNKNOWN	UNKNOWN	NA	LMRL	72.2	26.8	68.9	31.94	M
10278	(P)UNKNOWN	UNKNOWN	NA	LLRM	67.3	23.0	66.3	28.08	F
10297	(P)UNKNOWN	UNKNOWN	NA	LLRM	66.4	27.2	65.7	30.08	F
10284	(P)UNKNOWN	UNKNOWN	NA	LMRL	66.8	24.7	66.3	28.75	F
10291	(P)UNKNOWN	UNKNOWN	NA	LLRM	67.7	25.2	66.0	29.58	F
10297	(P)UNKNOWN	UNKNOWN	NA	LLRM	66.4	27.2	65.7	30.08	F
10301	(P)UNKNOWN	UNKNOWN	NA	LLRM	71.3	23.0	68.5	29.51	
10302	(P)UNKNOWN	UNKNOWN	NA	LMRL	67.2	25.1	64.1	29.82	F
10303	(P)UNKNOWN	UNKNOWN	NA	LLRM	66.6	25.2	63.8	29.66	F
10304	(P)UNKNOWN	UNKNOWN	NA	LLRM	63.4	23.6	62.1	27.61	F

*LMRL = LEFT MEDIAL, RIGHT LATERAL
*LLRM = LEFT LATERAL, RIGHT MEDIAL

TABLE 6.3 : COMPLETE METACARPAL DATA TABLE AND RATIO 6 RESULTS

CAT.NO.	SIDE	GREATEST LENGTH	TRANS. PR.WIDTH	TRANS.W. CENT.SHAFT	TRANS. DT.WIDTH	RATIO 6	GENDER
1681	L	207.8	74.4	49.7	77.1	23.9	M
1782	L	193.0	63.4	38.2	65.0	19.8	F
9117	L	194.0	59.7	35.2	63.0	18.1	F
9118	L	195.1	65.2	37.4	66.6	19.2	F
9692	L	197.1	62.2	38.0	66.1	19.3	F
9948	L	209.2	58.1	36.7	60.9	17.5	F
10093	L	196.5	78.5	50.9	80.3	25.9	M
2921	R	203.0	67.1	38.2	69.8	18.8	F
6828	R	212.8	67.4	43.8	71.0	20.6	M
7876	R	202.7	70.3	43.9	75.0	21.7	M
9369	R	210.0	76.1	51.6	77.9	24.6	M

SUMMARY 6 FEMALES
5 MALES
11 TOTAL

TABLE 6.4: COMPLETE METATARSAL DATA TABLE AND RATIO 6 RESULTS

CAT.NO.	SIDE	GREATEST LENGTH	TRANS. PR.WIDTH	TRANS.W. CENT.SHAFT	TRANS. DT.WIDTH	RATIO 6	GENDER
9122	L	256.5	58.1	41.7	68.3	16.3	M
9947	L	251.4	51.1	28.8	61.3	11.5	F
9804	R	233.0	44.2	28.4	59.2	12.2	F
9810	R	257.2	57.1	38.6	68.0	15.0	M
3410	R	249.5	48.7	32.0	60.3	12.8	F

SUMMARY 3 FEMALES
2 MALES
5 TOTAL

TABLE 6.5 : DISTAL HUMERUS DATA TABLE

CAT. NUMBER	SIDE	GENDER	I	J	K	M	N	O
EgNn-1-499	L	M	9.37	5.80	9.16	8.45	3.89	4.97
EgNn-1-5505	L	F	8.00	4.96	7.95	7.18	3.53	3.87
EgNn-1-6534	L	F	8.18	5.23	8.03	7.16	3.53	3.90
EgNn-1-349	R	F	7.94	5.21	8.07	7.16	#NA	#NA
EgNn-1-2315	R	F	7.91	4.69	#NA	7.07	3.45	3.70
EgNn-1-4370	R	M	9.35	6.45	#NA	8.18	4.04	4.70
EgNn-1-6825	R	M	8.74	5.56	8.58	7.58	4.06	4.52
EgNn-1-7582	R	M	9.08	5.32	#NA	8.34	4.03	4.41
EgNn-1-10091	R	F	7.97	4.99	7.76	6.94	3.64	4.21

SUMMARY 5 FEMALES
4 MALES
9 TOTAL

TABLE 6.6: DISTAL HUMERUS CALCULATION RESULTS (after Walde 1985)

CAT.NUMBER	EQ. ONE (M)	EQ. ONE (F)	DIFF.EQ. ONE	EQ. TWO (M)	EQ. TWO (F)	DIFF.EQ. TWO
#499	298.35	291.31	7.04	288.55	282.36	6.19
#5505	219.01	225.54	-6.53	214.45	220.99	-6.54
#6534	227.37	232.81	-5.44	218.97	224.73	-5.77
#349	ND	ND	ND	ND	ND	ND
#2315	ND	ND	ND	207.34	215.41	-8.08
#4370	ND	ND	ND	290.61	284.97	5.64
#6825	260.59	259.69	0.90	262.21	260.14	2.06
#7582	ND	ND	ND	288.13	284.44	3.68
#10091	208.62	214.78	-6.17	210.45	215.53	-5.08
		SUMMARY	3 FEMALES			4 FEMALES
			1 MALE			4 MALES
			1 MALE?			1 NO DATA
			4 NO DATA			

CAT.NUMBER	EQ.THREE (M)	EQ.THREE (F)	DIFF.EQ.THREE		
#499	225.95	221.01	4.94		
#5505	162.37	167.73	-5.36		
#6534	170.30	174.53	-4.23		
#349	167.88	172.44	-4.57		
#2315	ND	ND	ND		
#4370	ND	ND	ND	SUMMARY	4 FEMALES
#6825	197.73	197.48	0.25		1 MALE
#7582	ND	ND	ND		1 MALE?
#10091	156.84	163.22	-6.38		3 NO DATA

TABLE 6.7: PROXIMAL RADIUS DATA TABLE

CAT. NUMBER	SIDE	GENDER	A	B	C	D
EgNn-1-2549	L	F	8.54	4.23	2.50	4.74
EgNn-1-3458	L	F	10.24	5.37	2.80	5.48
EgNn-1-4703	L	F	8.58	4.77	2.30	4.32
EgNn-1-6787	L	M	10.78	5.18	3.24	5.92
EgNn-1-7584	L	F	#NA	4.68	2.75	#NA
EgNn-1-7731	L	F	9.61	4.79	2.74	#NA
EgNn-1-2892	R	?	9.66	5.23	2.94	5.82
EgNn-1-3189	R	F	7.95	4.35	2.28	4.54
EgNn-1-5422	R	F	9.40	5.11	2.99	4.38
EgNn-1-4835	R	F	8.39	4.54	2.51	4.47
EgNn-1-5985	R	F	8.58	4.81	2.72	4.74
EgNn-1-6096	R	F	8.80	4.84	2.64	5.23
EgNn-1-6097	R	F	8.72	4.42	2.64	4.44
EgNn-1-6826	R	M	9.13	5.14	#NA	#NA
EgNn-1-9799	R	F	7.34	4.16	2.52	#NA
EgNn-1-9951	R	M	10.35	5.46	3.13	5.35

SUMMARY 12 FEMALES
3 MALES
1 UNASSIGNED
16 TOTAL

TABLE 6.8:
PROXIMAL RADIUS CALCULATIONS RESULTS (after Walde 1985)

CAT. NUMBER	EQ. ONE (M)	EQ. ONE (F)	DIFF. EQ. ONE	EQ. TWO (M)	EQ. TWO (F)	DIFF. EQ. TWO
#2549	264.47	284.28	-19.81	231.64	250.48	-18.83
#3458	415.77	416.90	-1.13	378.24	379.95	-1.71
#4703	286.09	307.97	-21.88	278.40	296.07	-17.66
#6787	434.65	427.04	7.62	380.85	375.86	4.99
#7584	ND	ND	ND	ND	ND	ND
#7731	ND	ND	ND	310.35	318.86	-8.50
#2892	424.72	422.28	2.44	356.65	357.96	-1.31
#3189	258.33	282.19	-23.86	226.28	248.70	-22.43
#5422	341.83	349.53	-7.70	341.36	343.20	-1.83
#4835	279.32	298.50	-19.18	257.73	274.00	-16.27
#5985	324.34	336.18	-11.84	291.21	301.35	-10.14
#6096	349.58	359.08	-9.49	296.67	307.61	-10.94
#6097	270.90	289.09	-18.19	255.96	270.54	-14.58
#6826	ND	ND	ND	ND	ND	ND
#9799	ND	ND	ND	201.60	222.37	-20.78
#9951	427.69	423.70	3.99	395.96	391.11	4.85

SUMMARY	8 FEMALES	11 FEMALES
	8 MALES	2 MALES
	1 FEMALE?	1 FEMALE?
	4 NO DATA	2 NO DATA

TABLE 6.8 (Con't):
PROXIMAL RADIUS CALCULATIONS RESULTS (after Walde 1985)

CAT. NUMBER	EQ.FIVE (M)	EQ.FIVE (F)	DIFF.EQ.FIVE	EQ. SIX (M)	EQ. SIX (F)	DIFF.EQ.SIX
#2549	204.22	223.86	-19.64	198.85	208.64	-9.79
#3458	341.30	344.49	-3.20	323.42	314.41	9.01
#4703	253.05	271.38	-18.33	240.38	244.52	-4.14
#6787	341.51	338.17	3.33	321.46	312.09	9.37
#7584	264.52	275.18	-10.66	ND	ND	ND
#7731	275.91	285.72	-9.81	265.40	264.96	0.44
#2892	332.78	334.65	-1.87	299.64	294.52	5.12
#3189	206.81	229.48	-22.67	194.40	205.48	-11.08
#5422	322.19	324.25	-2.06	284.68	281.88	2.80
#4835	238.12	254.65	-16.53	218.74	226.02	-7.28
#5985	277.13	287.13	-10.00	243.39	247.12	-3.73
#6096	276.60	287.83	-11.23	250.67	253.16	-2.49
#6097	231.30	246.50	-15.20	217.25	224.35	-7.10
#6826	ND	ND	ND	280.77	278.82	1.95
#9799	197.61	217.53	-19.93	166.18	181.78	-15.60
#9951	366.53	362.64	3.90	332.70	322.31	10.39

SUMMARY	EQ. FIVE	EQ. SIX
	13 FEMALES	8 FEMALES
	2 MALES	6 MALES
	1 NO DATA	1 MALE?
		1 NO DATA

TABLE 6.8 (Con't):
PROXIMAL RADIUS CALCULATIONS RESULTS (after Walde 1985)

CAT. NUMBER	EQ.THREE (M)	EQ.THREE (F)	DIFF.EQ.THREE	EQ.FOUR (M)	EQ.FOUR (F)	DIFF.EQ.FOUR
#2549	242.83	255.02	-12.19	172.06	189.43	-17.37
#3458	376.31	368.46	7.84	252.96	259.14	-6.18
#4703	258.22	268.09	-9.86	159.52	181.07	-21.55
#6787	391.44	381.05	10.39	302.70	297.92	4.77
#7584	ND	ND	ND	ND	ND	ND
#7731	ND	ND	ND	226.55	235.78	-9.23
#2892	379.38	371.93	7.44	242.26	247.06	-4.80
#3189	235.14	249.00	-13.86	135.90	159.64	-23.75
#5422	292.37	296.60	-4.23	236.57	241.03	-4.45
#4835	248.56	260.03	-11.47	167.46	185.04	-17.58
#5985	283.26	289.85	-6.59	188.81	201.35	-12.54
#6096	313.31	315.72	-2.40	190.99	204.64	-13.64
#6097	241.69	253.70	-12.01	188.17	202.04	-13.86
#6826	ND	ND	ND	ND	ND	ND
#9799	ND	ND	ND	131.12	151.42	-20.30
#9951	376.63	368.56	8.07	279.85	278.64	1.21

SUMMARY	8 FEMALES	12 FEMALES
	4 MALES	2 MALES
	4 NO DATA	2 NO DATA

TABLE 6.9:

PROXIMAL METACARPALS DATA TABLE

CAT. NUMBER	SIDE	GENDER	A	B
EgNn-1-1681	L	M	7.44	4.10
EgNn-1-1782	L	F	6.29	3.55
EgNn-1-4331	L	M	7.86	4.58
EgNn-1-7747	L	F	6.62	3.97
EgNn-1-9117	L	F	6.06	3.71
EgNn-1-9118	L	F	6.59	3.89
EgNn-1-9692	L	F	6.21	3.65
EgNn-1-9948	L	F	5.77	3.55
EgNn-1-10093	L	M	7.87	4.74
EgNn-1-2921	R	F	6.71	4.17
EgNn-1-6134	R	M	7.24	4.22
EgNn-1-6828	R	F	6.62	4.14
EgNn-1-7324	R	F	6.31	3.84
EgNn-1-7358	R	F	6.38	3.83
EgNn-1-7876	R	M	7.13	4.39
EgNn-1-9119	R	F	6.51	4.20
EgNn-1-9369	R	M	7.61	4.49

SUMMARY 11 FEMALES
6 MALES
17 TOTAL

TABLE 6.10:

PROXIMAL METACARPALS CALCULATION RESULTS
(after Walde 1985)

CAT.NUMBER	EQ. ONE (M)	EQ. ONE (F)	DIFF. EQ.ONE	EQ. TWO (M)	EQ. TWO (F)	DIFF. EQ.TWO
#1681	309.58	305.48	4.10	293.27	287.66	5.61
#1782	216.55	224.83	-8.28	202.87	209.35	-6.48
#4331	360.51	349.99	10.52	326.29	316.27	10.02
#7747	259.17	262.12	-2.95	228.81	231.82	-3.01
#9117	214.35	223.28	-8.92	184.79	193.69	-8.89
#9118	252.76	256.48	-3.72	226.45	229.78	-3.32
#9692	218.48	226.68	-8.20	196.58	203.90	-7.32
#9948	189.60	201.79	-12.19	161.99	173.94	-11.94
#10093	370.75	359.07	11.68	327.08	316.95	10.13
#2921	275.99	276.90	-0.91	235.89	237.95	-2.06
#6134	306.50	303.09	3.41	277.55	274.04	3.51
#6828	269.50	271.30	-1.79	228.81	231.82	-3.01
#7324	235.21	241.37	-6.16	204.44	210.71	-6.27
#7358	238.23	243.93	-5.70	209.95	215.48	-5.53
#7876	311.13	307.39	3.74	268.91	266.55	2.35
#9119	267.45	269.66	-2.21	220.17	224.33	-4.17
#9369	342.08	334.06	8.03	306.64	299.24	7.40

SUMMARY		
	10 FEMALES	11 FEMALES
	6 MALES	6 MALES
	1 FEMALE?	

TABLE 6.11:

DISTAL METACARPALS DATA TABLE

CAT. NUMBER	SIDE	GENDER	D	E	F	I	J
EgNn-1-1681	L	M	7.37	#NA	3.46	#NA	3.87
EgNn-1-1782	L	F	6.18	3.05	2.91	3.52	3.37
EgNn-1-9117	L	F	6.17	3.01	2.92	3.40	3.20
EgNn-1-9118	L	F	6.25	3.16	3.06	#NA	3.51
EgNn-1-9692	L	F	6.61	#NA	3.01	3.47	3.44
EgNn-1-9948	L	F	6.03	2.97	2.60	3.57	3.09
EgNn-1-10093	L	M	7.59	3.88	3.79	4.16	4.03
EgNn-1-2921	R	M	6.89	3.38	3.23	3.85	3.69
EgNn-1-3286	R	F?	6.37	3.38	3.15	3.65	3.56
EgNn-1-4518	R	F	#NA	3.33	3.11	#NA	3.32
EgNn-1-6782	R	F	6.70	3.31	2.96	3.53	3.44
EgNn-1-6828	R	M	6.96	3.39	3.26	3.76	3.63
EgNn-1-7359	R	F	6.32	3.06	2.92	3.59	3.41
EgNn-1-7876	R	M	7.42	3.62	3.39	3.93	#NA
EgNn-1-9369	R	M	7.40	3.85	3.68	4.29	4.04
EgNn-1-9370	R	F	#NA	3.36	2.97	3.55	3.25
EgNn-1-9949	R	F	5.68	2.93	2.72	3.37	3.18
EgNn-1-10094	R	M?	6.48	3.05	3.21	3.44	3.43

SUMMARY
10 FEMALES
6 MALES
2 UNASSIGNED
18 TOTAL

TABLE 6.12:

DISTAL METACARPAL CALCULATION RESULTS (after Walde 1985)

CAT.NUMBER	EQ.ONE(M)	EQ.ONE(F)	DIFF.EQ.ONE	EQ.TWO(M)	EQ.TWO(F)	DIFF.EQ.TWO
#1681	ND	ND	ND	ND	ND	ND
#1782	328.05	334.04	-5.99	207.13	212.57	-5.44
#9117	304.55	311.59	-7.04	208.71	213.86	-5.15
#9118	363.57	365.57	-1.99	224.33	226.48	-2.15
#9692	ND	ND	ND	ND	ND	ND
#9948	249.73	264.35	-14.63	168.33	180.82	-12.50
#10093	503.31	487.74	15.57	341.24	327.34	13.89
#2921	403.02	400.60	2.42	262.62	261.01	1.61
#3286	372.92	373.27	-0.35	234.35	234.77	-0.41
#4518	332.80	335.80	-3.00	ND	ND	ND
#6782	333.86	339.01	-5.16	226.63	231.19	-4.56
#6828	396.94	394.41	2.54	268.38	266.07	2.31
#7359	335.08	340.56	-5.48	213.23	218.41	-5.18
#7876	ND	ND	ND	295.29	290.22	5.07
#9369	492.61	479.21	13.40	322.44	311.09	11.35
#9370	303.35	309.99	-6.64	ND	ND	ND
#9949	280.26	291.47	-11.22	169.70	179.49	-9.79
#10094	374.37	373.48	0.89	252.01	250.44	1.57

SUMMARY	EQ. ONE	EQ. TWO
	9 FEMALES	7 FEMALES
	4 MALES	5 MALES
	1 FEMALE?	1 FEMALE?
	1 MALE?	1 MALE?
	3 NO DATA	4 NO DATA

TABLE 6.12 (Con't):

DISTAL METACARPAL CALCULATION RESULTS (after Walde 1985)

CAT.NUMBER	EQ.THREE(M)	EQ.THREE(F)	DIFF.EQ.THREE
#1681	450.07	442.56	7.51
#1782	326.87	332.98	-6.11
#9117	303.00	310.23	-7.23
#9118	354.47	356.76	-2.29
#9692	351.78	355.65	-3.86
#9948	271.01	284.95	-13.94
#10093	491.57	476.81	14.76
#2921	403.11	401.08	2.03
#3286	368.22	368.51	-0.29
#4518	ND	ND	ND
#6782	352.08	356.89	-4.82
#6828	397.63	395.53	2.10
#7359	336.51	342.17	-5.67
#7876	ND	ND	ND
#9369	483.70	470.83	12.86
#9370	ND	ND	ND
#9949	279.60	290.52	-10.93
#10094	355.08	355.29	-0.20

SUMMARY
8 FEMALES
5 MALES
2 FEMALE?
3 NO DATA

TABLE 6.13

DISTAL TIBIAS DATA TABLE

CAT.NUMBER	SIDE	GENDER	H	I	J
EgNn-1-1879	L	F	6.38	4.65	4.82
EgNn-1-2864	L	F	6.43	4.91	4.78
EgNn-1-2957	L	?	6.96	5.04	5.30
EgNn-1-4318	L	M	7.83	5.52	5.31
EgNn-1-7585	L	?	7.17	5.45	4.96
EgNn-1-7586	L	F	7.24	5.22	4.81
EgNn-1-9816	L	F	6.22	4.63	4.64
EgNn-1-9997	L	M	7.61	5.25	5.40
EgNn-1-348	R	M	7.25	5.25	5.19
EgNn-1-1937	R	F	6.91	4.80	5.04
EgNn-1-4777	R	F	6.59	4.81	4.72
EgNn-1-5575	R	M	7.39	5.37	5.33
EgNn-1-6785	R	F	6.87	5.09	4.88
EgNn-1-6823	R	F	6.35	4.60	4.71
EgNn-1-7587	R	F	6.17	4.62	#NA
EgNn-1-9815	R	F	6.53	5.26	#NA
EgNn-1-9999	R	F	6.47	#NA	4.68

SUMMARY 11 FEMALES
4 MALES
2 UNASSIGNED
17 TOTAL

TABLE 6.14:

DISTAL TIBIA CALULATIONS RESULTS (after Walde 1985)

CAT.NUMBER	EQ.ONE (M)	EQ.ONE (F)	DIFF.EQ.ONE	EQ.TWO (M)	EQ.TWO (F)	DIFF.EQ.TWO
#1879	402.46	409.90	-7.43	267.02	275.95	-8.93
#2864	400.09	407.69	-7.60	282.32	289.99	-7.67
#2957	491.96	489.35	2.61	325.55	327.70	-2.15
#4318	538.20	529.53	8.67	408.60	400.89	7.70
#7585	460.68	460.95	-0.26	358.92	357.82	1.10
#7586	445.71	447.39	-1.68	353.44	352.34	1.10
#9816	371.88	382.68	-10.80	254.84	265.38	-10.54
#9997	537.98	529.67	8.31	380.87	376.10	4.77
#348	493.33	490.13	3.19	355.50	354.22	1.28
#1937	457.15	458.17	-1.03	311.16	314.51	-3.35
#4777	400.93	408.20	-7.26	289.07	295.48	-6.42
#5575	517.92	512.00	5.92	370.80	367.80	2.99
#6785	435.25	438.57	-3.33	321.48	324.35	-2.87
#6823	387.28	396.31	-9.03	262.64	272.01	-9.37
#7587	ND	ND	ND	250.87	261.92	-11.05
#9815	ND	ND	ND	305.22	310.88	-5.66
#9999	389.77	398.36	-8.59	ND	ND	ND

SUMMARY	8 FEMALES	10 FEMALES
	5 MALES	3 MALES
	2 FEMALE?	3 MALE?
	2 NO DATA	1 NO DATA

TABLE 6.15:

PROXIMAL METATARSALS DATA TABLE & EQUATION RESULTS
(after Walde 1985)

CAT. NUMBER	SIDE	GENDER	A	B	EQ. ONE (M)	EQ. ONE (F)	DIFF.EQ. ONE
EgNn-1-1936	L	F	4.39	4.49	185.59	197.19	-11.61
EgNn-1-1977	L	F	5.24	5.07	259.82	261.64	-1.82
EgNn-1-2035	L	F	4.87	4.78	224.69	230.90	-6.22
EgNn-1-2721	L	F	5.28	5.02	257.50	259.14	-1.64
EgNn-1-5844	L	F	5.08	5.06	253.31	256.61	-3.30
EgNn-1-6958	L	F	5.17	4.91	245.27	248.30	-3.03
EgNn-1-7443	L	F	5.14	4.97	248.70	251.79	-3.09
EgNn-1-9122	L	M	5.94	5.51	318.13	312.02	6.11
EgNn-1-9947	L	F	5.10	5.01	250.27	253.57	-3.30
EgNn-1-2005	R	F	5.17	4.93	246.77	249.73	-2.96
EgNn-1-3451	R	F	4.93	4.85	232.11	237.53	-5.42
EgNn-1-4837	R	M	5.66	5.55	311.06	307.33	3.72
EgNn-1-5636	R	M	5.59	5.50	304.77	301.87	2.91
EgNn-1-5738	R	F	4.99	5.07	250.82	254.90	-4.08
EgNn-1-6139	R	F?	5.25	5.18	268.46	269.79	-1.33
EgNn-1-6702	R	F	5.24	4.80	239.51	242.31	-2.80
EgNn-1-6783	R	F?	5.33	5.14	268.33	269.08	-0.75
EgNn-1-7112	R	F?	5.35	5.14	269.05	269.62	-0.57
EgNn-1-7738	R	F	4.91	4.83	229.89	235.56	-5.67
EgNn-1-7739	R	M?	5.36	5.32	282.95	282.78	0.18
EgNn-1-9123	R	M	5.57	5.47	301.80	299.18	2.62
EgNn-1-9804	R	F	4.43	4.12	159.19	171.79	-12.59
EgNn-1-9810	R	M	5.81	5.94	345.80	339.30	6.50

SUMMARY	
	14 FEMALES
	5 MALES
	4 UNASSIGNED
	23 TOTAL

TABLE 6.16: DISTAL METATARSALS DATA TABLE

CAT. NUMBER	SIDE	GENDER	D	E	F	I	J
EgNn-1-1712	L	M	6.87	3.41	3.29	4.22	4.14
EgNn-1-2722	L	M?	6.06	3.04	2.84	3.85	3.68
EgNn-1-3581	L	F	5.81	2.80	2.66	3.66	3.44
EgNn-1-3738	L	M	6.06	3.11	3.06	3.49	3.65
EgNn-1-4093	L	M	6.83	3.32	3.11	4.06	3.77
EgNn-1-2994	L	F	5.69	2.73	2.62	3.55	3.36
EgNn-1-7444	L	F	5.91	2.79	2.67	3.76	3.43
EgNn-1-9122	L	M	6.53	3.28	3.04	3.87	3.54
EgNn-1-9809	L	F	5.61	2.69	2.66	3.20	3.14
EgNn-1-9947	L	F	6.00	2.87	2.71	3.65	3.38
EgNn-1-10095	L	F?	6.16	#NA	#NA	3.65	3.47
EgNn-1-3451	R	F	5.90	2.86	2.79	3.60	3.47
EgNn-1-4761	R	F	5.64	2.71	2.64	3.44	3.23
EgNn-1-5092	R	M?	5.95	2.85	2.93	3.63	3.49
EgNn-1-6535	R	F	5.83	2.73	2.85	3.64	3.89
EgNn-1-6296	R	M	6.39	3.21	3.01	3.88	3.65
EgNn-1-6365	R	M	6.75	3.31	3.11	4.14	4.02
EgNn-1-6616	R	M?	6.09	2.94	2.90	3.76	3.63
EgNn-1-6701	R	M?	6.19	3.01	2.91	3.67	3.51
EgNn-1-6927	R	M	6.34	3.15	3.11	#NA	#NA
EgNn-1-7743	R	F	6.04	2.86	2.69	3.40	3.70
EgNn-1-7744	R	F	5.76	2.80	2.69	3.48	3.43
EgNn-1-9120	R	F	5.99	2.84	2.72	3.44	3.32
EgNn-1-9371	R	F	5.88	2.95	2.77	3.74	3.65
EgNn-1-9804	R	F	5.80	2.81	2.69	3.43	3.30
EgNn-1-9810	R	M	6.54	3.30	3.09	4.04	3.77

SUMMARY

13 FEMALES
8 MALES
5 UNASSIGNED
26 TOTAL

TABLE 6.17: DISTAL METATARSAL EQUATION RESULTS (after Walde 1985)

CAT.NUMBER	EQ.ONE(M)	EQ.ONE(F)	DIFF.EQ.ONE	EQ.TWO(M)	EQ.TWO(F)
#1712	432.06	420.06	12.00	499.08	488.38
#2722	333.38	332.79	0.59	402.90	402.18
#3581	296.72	300.79	-4.07	357.24	360.42
#3738	349.57	345.57	4.00	375.75	373.97
#4093	414.96	406.07	8.89	454.26	444.63
#2994	283.40	288.85	-5.45	337.93	342.54
#7444	304.39	307.94	-3.55	370.01	371.40
#9122	387.40	380.94	6.46	418.70	409.93
#9809	279.02	284.42	-5.40	291.77	296.90
#9947	315.81	318.06	-2.25	358.70	359.66
#10095	ND	ND	ND	ND	ND
#3451	313.39	314.98	-1.59	361.40	362.52
#4761	280.48	285.95	-5.47	322.29	325.93
#5092	325.81	325.25	0.56	376.80	374.34
#6535	308.50	310.10	-1.61	382.12	388.15
#6296	373.26	368.13	5.13	420.23	413.97
#6365	408.84	400.33	8.51	470.99	464.24
#6616	336.63	335.51	1.12	394.73	393.21
#6701	346.56	344.56	1.99	381.49	378.92
#6927	374.39	368.31	6.07	ND	ND
#7743	317.15	319.56	-2.41	335.18	345.27
#7744	295.01	298.87	-3.86	337.22	342.03
#9120	314.88	317.16	-2.28	331.85	334.63
#9371	313.17	314.73	-1.56	382.47	384.78
#9804	298.21	301.86	-3.64	327.51	330.93
#9810	391.93	384.63	7.29	450.10	441.30

<u>SUMMARY</u> 12 FEMALES
9 MALES
1 FEMALE?
3 MALE?
1 NO DATA

TABLE 6.17 (Con't): DISTAL METATARSAL EQUATION RESULTS (after Walde 1985)

CAT.NUMBER	DIFF.EQ.TWO	EQ.THREE(M)	EQ.THREE(F)	DIFF.EQ.THREE
#1712	10.69	528.73	520.41	8.33
#2722	0.72	427.75	428.13	-0.37
#3581	-3.18	385.66	388.93	-3.27
#3738	1.79	386.43	391.71	-5.28
#4093	9.63	499.34	490.36	8.97
#2994	-4.61	364.19	369.43	-5.25
#7444	-1.39	402.63	403.44	-0.82
#9122	8.77	454.51	448.99	5.53
#9809	-5.13	314.63	323.68	-9.04
#9947	-0.96	394.35	395.47	-1.11
#10095	ND	406.04	406.48	-0.44
#3451	-1.12	384.97	388.53	-3.57
#4761	-3.64	345.66	351.78	-6.12
#5092	2.46	391.80	394.65	-2.85
#6535	-6.03	395.52	402.93	-7.41
#6296	6.25	450.00	446.62	3.39
#6365	6.75	509.68	502.54	7.14
#6616	1.52	418.17	419.11	-0.94
#6701	2.57	411.05	411.28	-0.23
#6927	ND	ND	ND	ND
#7743	-10.09	376.31	383.52	-7.21
#7744	-4.81	362.15	368.38	-6.23
#9120	-2.78	368.63	372.31	-3.69
#9371	-2.31	403.93	407.29	-3.36
#9804	-3.42	355.73	361.14	-5.41
#9810	8.80	479.86	473.86	6.00

	DIFF.EQ.TWO	DIFF.EQ.THREE
	11 FEMALES	13 FEMALES
	9 MALES	6 MALES
	2 FEMALE?	6 FEMALE?
	2 MALE?	1 NO DATA
	2 NO DATA	

TABLE 7.1: OBSERVED VS. EXPECTED ELEMENTS IN RAMSAY FAUNAL COLLECTION

	LEFT	RIGHT	TOTAL OBSERVED	EXPECTED	%
Mand Mol3 (MNI)	40	50	90	100	90.0
Prox Humerus	4	3	7	100	7.0
Distal Humerus	10	9	19	100	19.0
Prox Radius	15	17	32	100	32.0
Dist Radius	15	12	27	100	27.0
Prox Ulna	13	15	28	100	28.0
Prox Metacarpal	7	8	15	100	15.0
Dist Metacarpal	5	6	11	100	11.0
Lunate	8	6	14	100	14.0
Magnum	4	2	6	100	6.0
Pisiform	1	2	3	100	3.0
Unciform	7	9	16	100	16.0
Scaphoid	2	7	9	100	9.0
Cuneiform	8	4	12	100	12.0
Vestigal C5	0	1	1	100	1.0
Prox Femur	5	4	9	100	9.0
Dist Femur	4	0	4	100	4.0
Prox Tibia	3	3	6	100	6.0
Dist Tibia	7	10	17	100	17.0
Prox Metatarsal	16	14	30	100	30.0
Dist Metatarsal	8	5	13	100	13.0
Patella	7	2	9	100	9.0
Calcaneus	12	13	25	100	25.0
Astragulus	15	7	22	100	22.0
Ext-Mid Cuneiform	12	18	30	100	30.0
Naviculo-Cuboid	13	11	24	100	24.0
Lat Malleolus	6	4	10	100	10.0
Phlg 1	-	-	42	400	10.5
Phlg 2	-	-	51	400	12.8
Phlg 3	-	-	49	400	12.3
Scapula	24	25	49	100	49.0
Innominate	23	15	38	100	38.0
Auditory Meatus	9	14	23	100	23.0
Atlas	-	-	9	50	18.0
Axis	-	-	13	50	26.0
Cervical Vert	-	-	69	250	27.6
Thoracic Vert	-	-	24	700	3.4
Lumbar Vert	-	-	5	250	2.0
Sacrum	-	-	5	50	10.0
Caudal Vert	-	-	3	500	0.6
Rib	77	74	151	700	21.6

TABLE 7.2 : OBSERVED VS. EXPECTED ELEMENTS IN AREA "A"

	LEFT	RIGHT	TOTAL OBSERVED	EXPECTED	%
Mand Mol3 (MNI)	5	6	11	12	91.7
Prox Humerus	1	2	3	12	25.0
Distal Humerus	2	1	3	12	25.0
Prox Radius	0	2	2	12	16.7
Dist Radius	2	0	2	12	16.7
Prox Ulna	1	3	4	12	33.3
Prox Metacarpal	1	3	4	12	33.3
Dist Metacarpal	0	1	1	12	8.3
Lunate	2	2	4	12	33.3
Magnum	0	1	1	12	8.3
Pisiform	1	0	1	12	8.3
Unciform	1	2	3	12	25.0
Scaphoid	0	3	3	12	25.0
Cuneiform	0	1	1	12	8.3
Vestigal C5	0	0	0	12	0.0
Prox Femur	1	0	1	12	8.3
Dist Femur	3	0	3	12	25.0
Prox Tibia	0	0	0	12	0.0
Dist Tibia	2	1	3	12	25.0
Prox Metatarsal	3	0	3	12	25.0
Dist Metatarsal	0	1	1	12	8.3
Patella	2	0	2	12	16.7
Calcaneus	1	4	5	12	41.7
Astragulus	3	2	5	12	41.7
Ext-Mid Cuneiform	4	2	6	12	50.0
Naviculo-Cuboid	4	1	5	12	41.7
Lat Malleolus	2	0	2	12	16.7
Phlg 1	-	-	12	48	25.0
Phlg 2	-	-	8	48	16.7
Phlg 3	-	-	6	48	12.5
Scapula	3	3	6	12	50.0
Innominate	2	0	2	12	16.7
Auditory Meatus	1	0	1	12	8.3
Atlas	-	-	0	6	0.0
Axis	-	-	0	6	0.0
Cervical Vert (3-7)	-	-	0	30	0.0
Thoracic Vert	-	-	0	84	0.0
Lumbar Vert	-	-	0	30	0.0
Sacrum	-	-	2	6	33.3
Caudal Vert	-	-	0	60	0.0
Rib	10	6	16	168	9.5

TABLE 7.3: OBSERVED VS. EXPECTED ELEMENTS IN AREA "B"

	LEFT	RIGHT	TOTAL OBSERVED	EXPECTED	%
Mand Mol3 (MNI)	31	39	70	78	89.7
Prox Humerus	1	1	2	78	2.6
Distal Humerus	8	6	14	78	17.9
Prox Radius	9	11	20	78	25.6
Dist Radius	7	8	15	78	19.2
Prox Ulna	10	9	19	78	24.4
Prox Metacarpal	2	4	6	78	7.7
Dist Metacarpal	2	4	6	78	7.7
Lunate	4	2	6	78	7.7
Magnum	2	0	2	78	2.6
Pisiform	0	2	2	78	2.6
Unciform	6	5	11	78	14.1
Scaphoid	2	4	6	78	7.7
Cuneiform	5	3	8	78	10.3
Vestigal C5	0	1	1	78	1.3
Prox Femur	2	3	5	78	6.4
Dist Femur	1	0	1	78	1.3
Prox Tibia	2	1	3	78	3.8
Dist Tibia	4	6	10	78	12.8
Prox Metatarsal	13	10	23	78	29.5
Dist Metatarsal	7	4	11	78	14.1
Patella	4	2	6	78	7.7
Calcaneus	9	6	15	78	19.2
Astragulus	8	4	12	78	15.4
Ext-Mid Cuneiform	7	14	21	78	26.9
Naviculo-Cuboid	8	7	15	78	19.2
Lat Malleolus	3	2	5	78	6.4
Phlg 1	-	-	26	624	4.2
Phlg 2	-		40	624	6.4
Phlg 3	-		33	624	5.3
Scapula	2	3	5	78	6.4
Innominate	1	0	1	78	1.3
Auditory Meatus	5	10	15	78	19.2
Atlas	-	-	5	39	12.8
Axis	-	-	6	39	15.4
Cervical Vert (3-7)	-	-	31	195	15.9
Thoracic Vert	-	-	8	546	1.5
Lumbar Vert	-	-	2	195	1.0
Sacrum	-	-	4	39	10.3
Caudal Vert	-	-	3	390	0.8
Rib	46	40	86	546	15.8

TABLE 7.4: OBSERVED VS. EXPECTED ELEMENTS IN AREA "C"

	LEFT	RIGHT	TOTAL OBSERVED	EXPECTED	%
Mand Mol3	4	5	9	16	56.3
Prox Humerus	2	0	2	16	12.5
Distal Humerus	0	2	2	16	12.5
Prox Radius	2	4	6	16	37.5
Dist Radius	6	4	10	16	62.5
Prox Ulna	2	3	5	16	31.3
Prox Metacarpal	4	1	5	16	31.3
Dist Metacarpal	3	1	4	16	25.0
Lunate	2	2	4	16	25.0
Magnum	2	1	3	16	18.8
Pisiform	0	0	0	16	0.0
Unciform	0	2	2	16	12.5
Scaphoid	0	0	0	16	0.0
Cuneiform	3	0	3	16	18.8
Vestigal C5	0	0	0	16	0.0
Prox Femur	2	1	3	16	18.8
Dist Femur	0	0	0	16	0.0
Prox Tibia	1	2	3	16	18.8
Dist Tibia	1	3	4	16	25.0
Prox Metatarsal	0	1	1	16	6.3
Dist Metatarsal	1	0	1	16	6.3
Patella	1	0	1	16	6.3
Calcaneus	2	3	5	16	31.3
Astragulus	4	1	5	16	31.3
Ext-Mid Cuneiform	1	2	3	16	18.8
Naviculo-Cuboid	1	3	4	16	25.0
Lat Malleolus	1	2	3	16	18.8
Phlg 1	-	-	4	64	6.3
Phlg 2	-	-	3	64	4.7
Phlg 3	-	-	10	64	15.6
Scapula	2	3	5	16	31.3
Innominate	1	2	3	16	18.8
Auditory Meatus	3	4	7	16	43.8
Atlas	-	-	4	8	50.0
Axis	-	-	7	8	87.5
Cervical Vert (MNI=8)	-	-	38	40	95.0
Thoracic Vert	-	-	16	112	14.3
Lumbar Vert	-	-	3	40	7.5
Sacrum	-	-	1	8	12.5
Caudal Vert	-	-	0	80	0.0
Rib	21	28	49	112	43.8

TABLE 7.5: END AND SIDE SCRAPER METRIC AND NON-METRIC ATTRIBUTES

Cat. Number	Provenience	Tool Type	#Working Edges	Mat. Type	Max. Length(mm)	Max. Width(mm)	Max. Thick(mm)
244	94S 51E/L2/SW	END/SIDE	2	SWD/HT	33.9	19.9	8.6
652	90S 117E/ALL/SE	END/SIDE	2	SWD	20.7	14.5	5.0
978	91S 120E/L1/NE	END	1	SWD	41.2	30.3	12.4
1533	92S 120E/L2/SE	SIDE	2	CCQ	72.0	54.2	27.9
2684	103S 99E/L2A/NW	END	1	KRF/PAT	29.6	18.5	4.9
2842	103S 99E/L2B/SW	END/SIDE	2	SWD/PAT	17.8	13.0	5.2
3430	104S 92E/L2B/SW	END	1	KRF/PAT	BROKEN	18.0	4.0
5229	104S 102E/L2A/NV	END/SIDE	2	SRC	43.1	24.4	10.2
5441	104S 103E/L2C/NW	END/SIDE	3	AGT	21.1	19.0	6.5
5924	95S 50E/L2A/NW	END/SIDE	2	SPT/HT	18.3	20.7	6.0
6182	60S 100E/ALL/SE	END/SIDE	2	CHT	15.0	13.0	3.8
10172	96W 61S/UNK/NA	END/SIDE	3	SWD	18.4	15.4	3.2
10180	102W 55S/UNK/NA	END	1	KRF	21.0	19.4	8.6
10197	(P) NO PROV.	SIDE	1	SPT	BROKEN	16.4	3.3
10416	85W 25S/UNK/NA	END	1	CHL	BROKEN	BROKEN	4.0

TABLE 7.5 (Con't): END AND SIDE SCRAPER METRIC AND NON-METRIC ATTRIBUTES

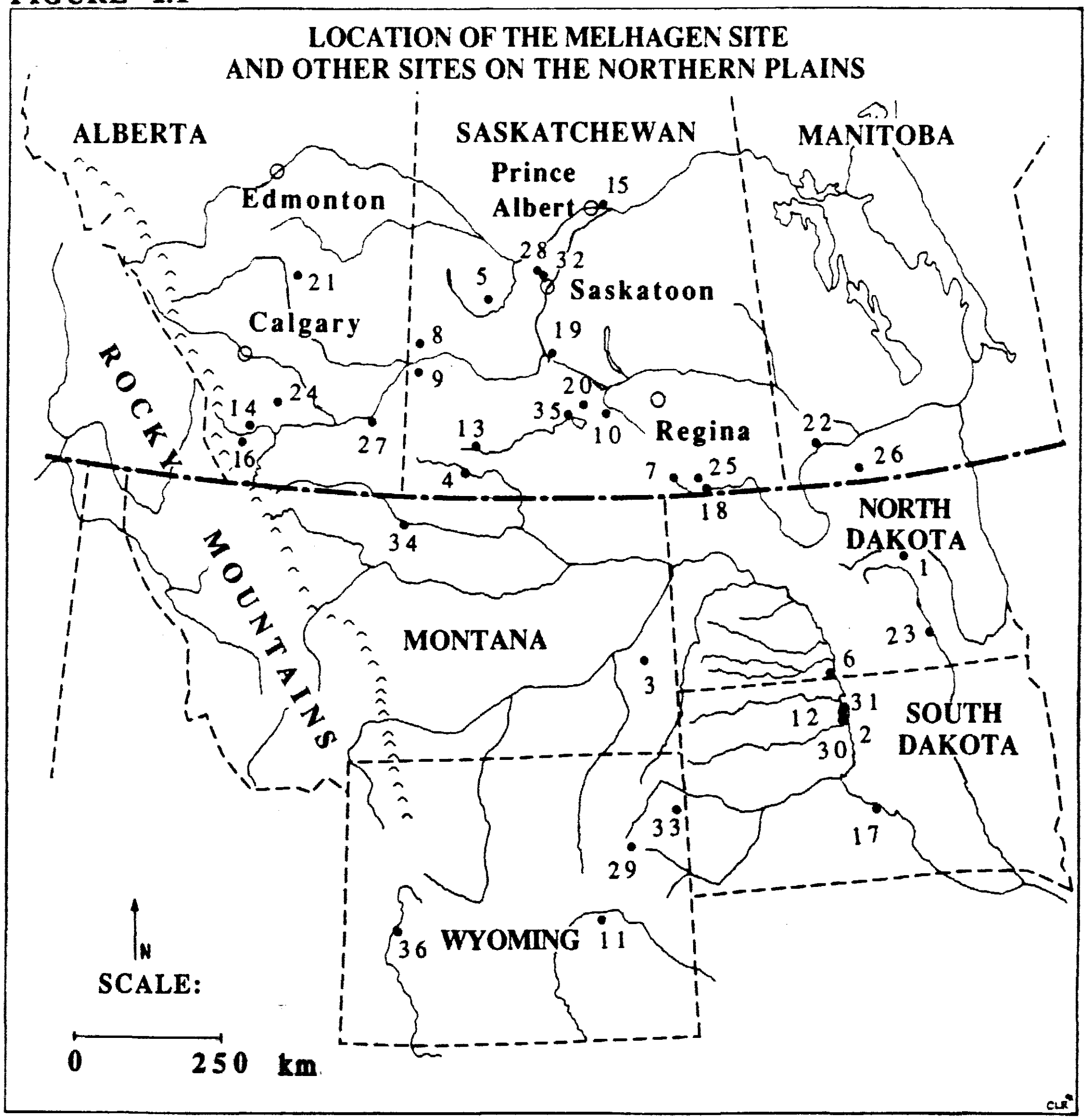
Cat. Number	Max.Work EdgeAngle	SideWork EdgeAngle	Wt.(gms)
244	67	57	6.9
652	64	52	1.7
978	70		15.7
1533	79	75	125.5
2684	79		2.9
2842	65	48	1.5
3430	44		1.1
5229	67	60	12.6
5441	66	61	2.8
5924	72	65	3.1
6182	57	53	0.8
10172	60	59	1.0
10180	84		3.6
10197		49	0.8
10416	68		0.6

TABLE 7.6: PESTLE, POUNDER AND CHOPPER METRIC & NON-METRIC ATTRIBUTES

Cat. Number	Provenience	Tool Type	Mat. Type	Modif. of Tool	Max. Length(mm)	Max. Width(mm)	Max. Thick(mm)
919	90S 119E	PESTLE	LIMESTONE?	GROUND	109.3	58.5	51.4
920	90S 119E	HAMMERSTONE	CCQ	PECKED	79.6	56.1	54.0
10901	SURFACE	CHOPPER	CCQ	FLAKED	100.6	124.0	40.4

Cat. Number	Wt.(gms)	No. Utilized Areas
919	438.4	1
920	365.9	3
10901	450.0	1

FIGURE 1.1


LOCATION OF THE MELHAGEN SITE
AND OTHER SITES ON THE NORTHERN PLAINS
ALBERTA
SASKATCHEWAN
MANITOBA
Edmonton
Prince Albert
Saskatoon
Calgary
Regina
ROCKY MOUNTAINS
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
SCALE:
0 250 km
N

SITES LOCATED IN FIGURE 1.1

No.	Site Name	Borden/County	No. Reference
1	Anderson Tipi Ring	32M111	(Deaver 1985)
2	Arpan Mound	39DW252	(Anderson 1975)
3	Ayers-Frazier Bison Trap	24PE30	(Clark and Wilson 1981)
4	Bakken-Wright	DiOa-1	(Adams 1975)
5	Biggar Bone		(Gibson 1978)
6	Boundary Mound/Alkire Mound	32SI200	(Neuman 1975)
7	Crane	DiMv-93	(Meyer and Rollans 1990)
8	Elma Thompson	EiOj-1	(Finnigan 1981; Finnigan and Johnson 1984)
9	Estuary Bison Pound	EfOk-16	(Adams 1977)
10	Garratt Site	EcNj-7	(Dyck 1983)
11	Glenrock Buffalo Jump	48C0304	(Frison 1970)
12	Grover Hand Mound	30DW240	(Neuman 1975)
13	Gull Lake Site	EaOd-1	(Kehoe 1973)
14	Head-Smashed-In	DkPj-1	(Brink and Dawe 1981)
15	Intake Site	FhNj-15	(Meyer and Rollans 1990)
16	Kenney Site	DkPj-1	(Reeves 1966; 1983)
17	La Roche	39ST9	(Neuman 1975)
18	Long Creek	DgMr-1	(Wettlaufer and Mayer-Oakes 1960)
19	Melhagen Site	EgNn-1	(Phenix 1969; Hall 1987; 1988)
20	Mortlach	EcNl-1	(Wettlaufer 1956)
21	Muhlbach	FbPf-100	(Gruhn 1971)
22	Mullett	DiMd-7	(Peach 1988)
23	Naze	32SN246	(Gregg 1987)
24	Old Women's Buffalo Jump		(Forbis 1962)
25	Rattigan	DhMs-10	(Meyer and Rollans 1990)
26	Richard's Kill Site		(Hlady 1967)
27	Ross Glenn	DlOp-2	(Quigg 1988)
28	Rousell	FbNs-2	(Dyck 1972)
29	Ruby	48CA302	(Frison 1971)
30	Stelzer	39DW242	(Neuman 1975)
31	Swift Bird Mound	39DW233	(Neuman 1975)
32	Tschetter	FbNr-1	(Dyck 1972; Prentice 1983; Linnamae 1988)
33	Vore	48CK302	(Reher and Frison 1980)
34	Wahkpa-Chu'gn	24HL101	(Davis and Stallcop 1966)
35	Walter Felt	EcNm-8	(Meyer and Rollans 1990)
36	Wardell	48SU301	(Frison 1973)

FIGURE 1.2

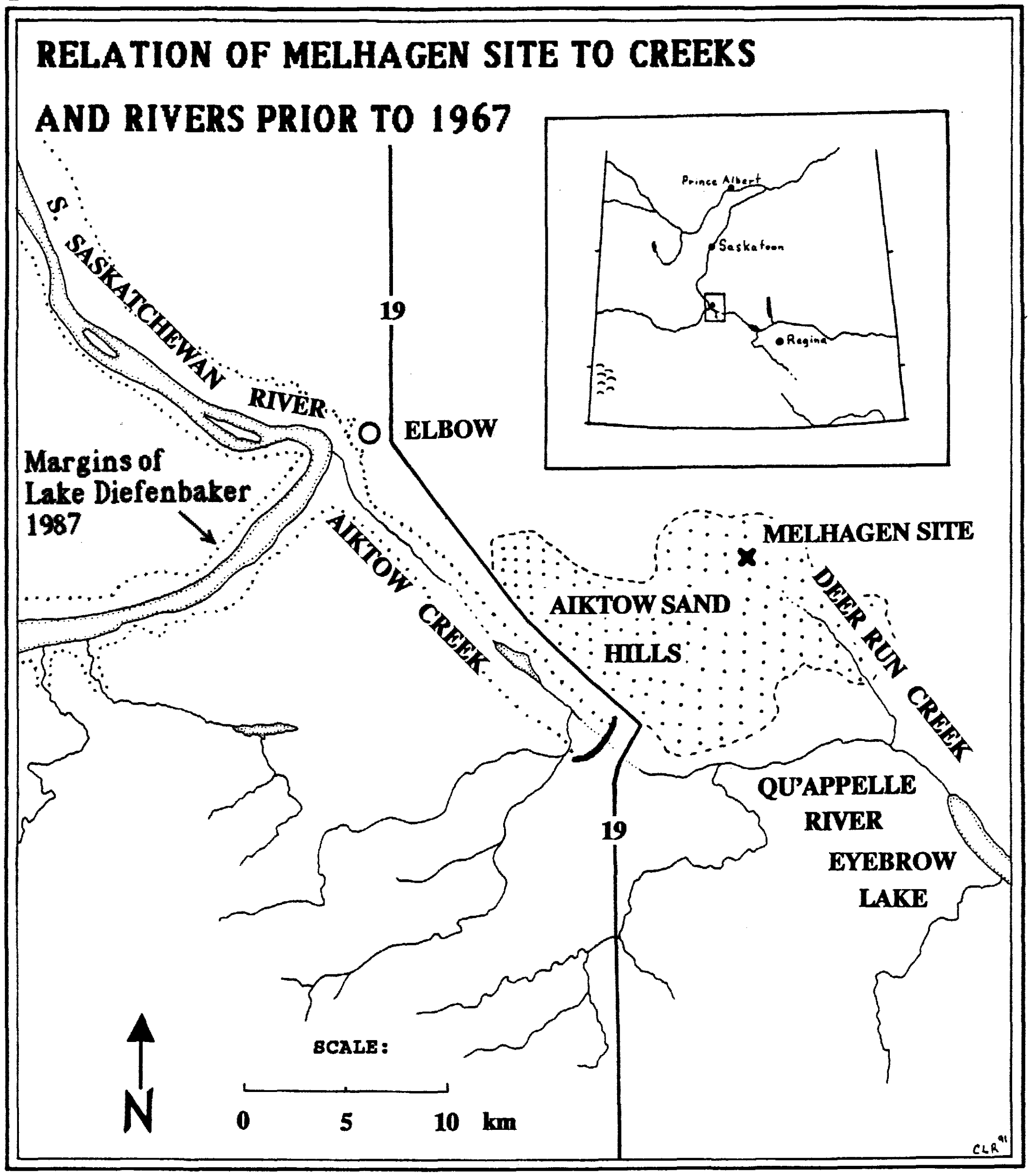
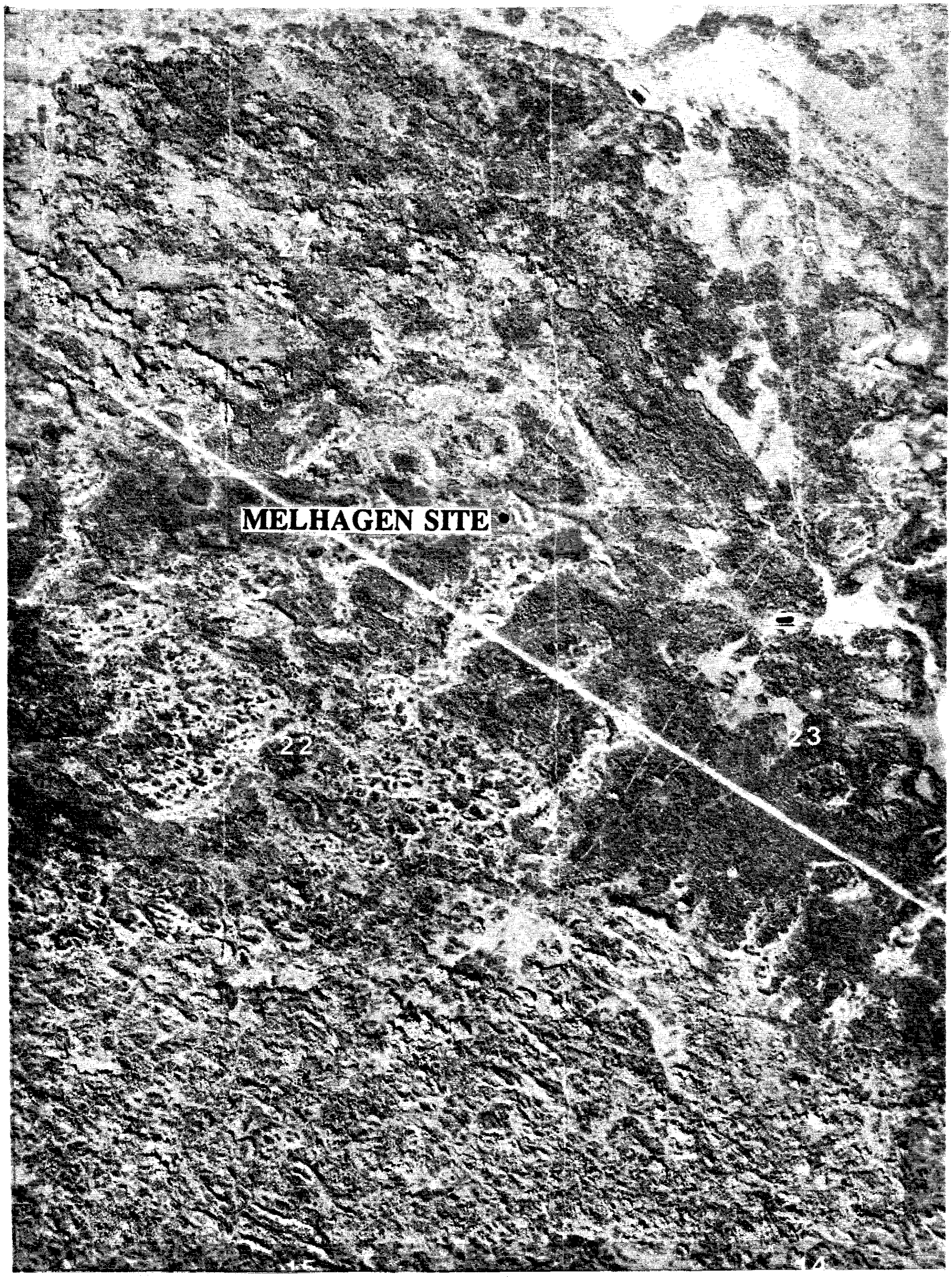

RELATION OF MELHAGEN SITE TO CREEKS
AND RIVERS PRIOR TO 1967
S. SASKATCHEWAN RIVER
19
ELBOW
Margins of
Lake Diefenbaker
1987
AIKTOW CREEK
MELHAGEN SITE
AIKTOW SAND
HILLS
DEER RUN CREEK
QU'APPELLE
RIVER
EYEBROW
LAKE
19
Prince Albert
Saskatoon
Regina
N
SCALE:
0 5 10 km
CLR 91

FIGURE 1.3: AIR PHOTO OF THE MELHAGEN SITE AREA



SCALE 1: 20,000

39-16

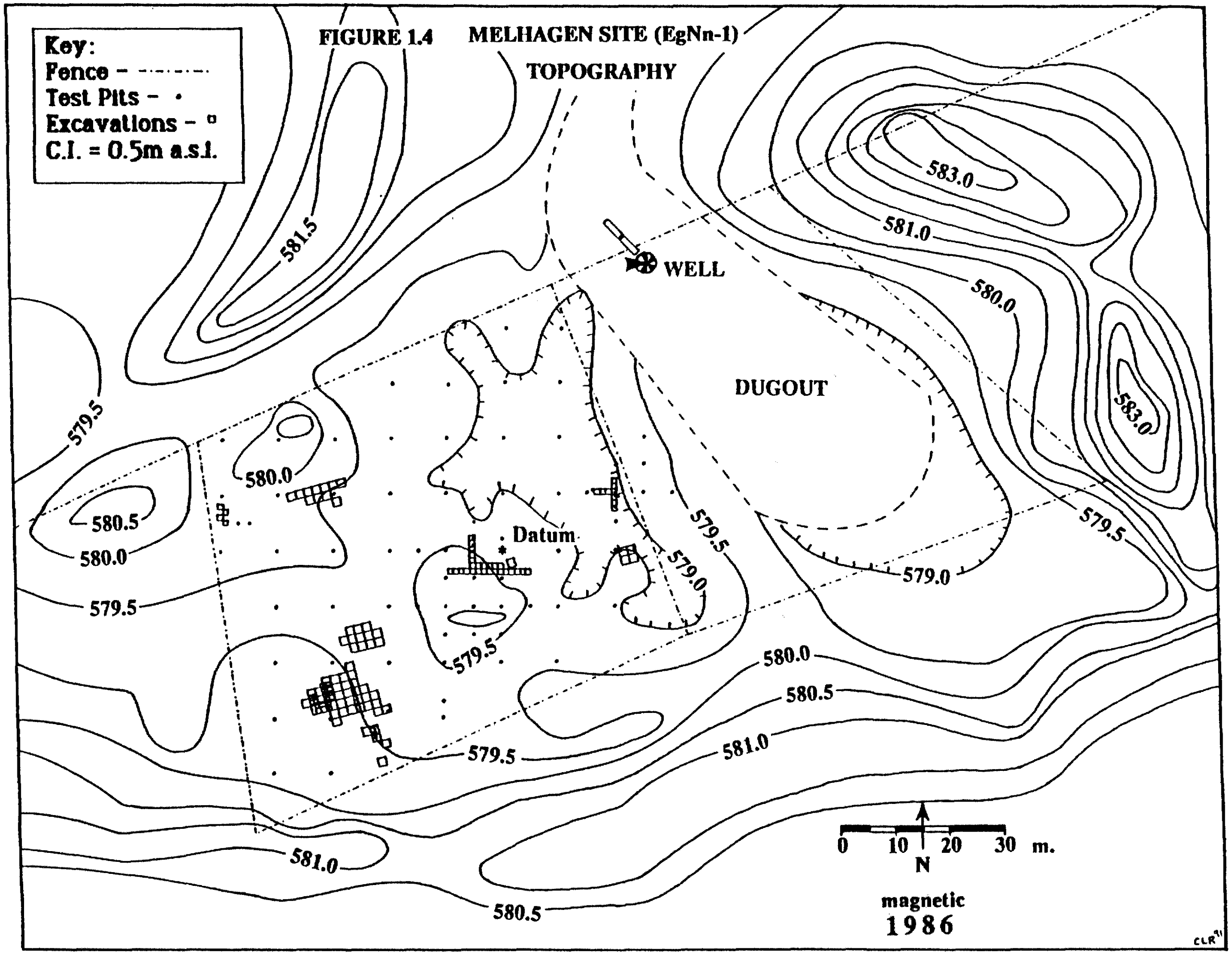


FIGURE 1.4
MELHAGEN SITE (EgNn-1)
TOPOGRAPHY
Key:
Fence -
Test Pits -
Excavations -
C.I. = 0.5m a.s.l.
581.5
583.0
581.0
580.0
583.0
WELL
DUGOUT
579.5
580.0
580.5
580.0
579.5
Datum
579.5
579.0
579.5
579.0
579.5
580.0
580.5
581.0
579.5
581.0
580.5
0
10
20
30
m.
N
magnetic
1986
CLR

FIGURE 1.5

MELHAGEN SITE (EgNn-1)
TESTS AND EXCAVATIONS

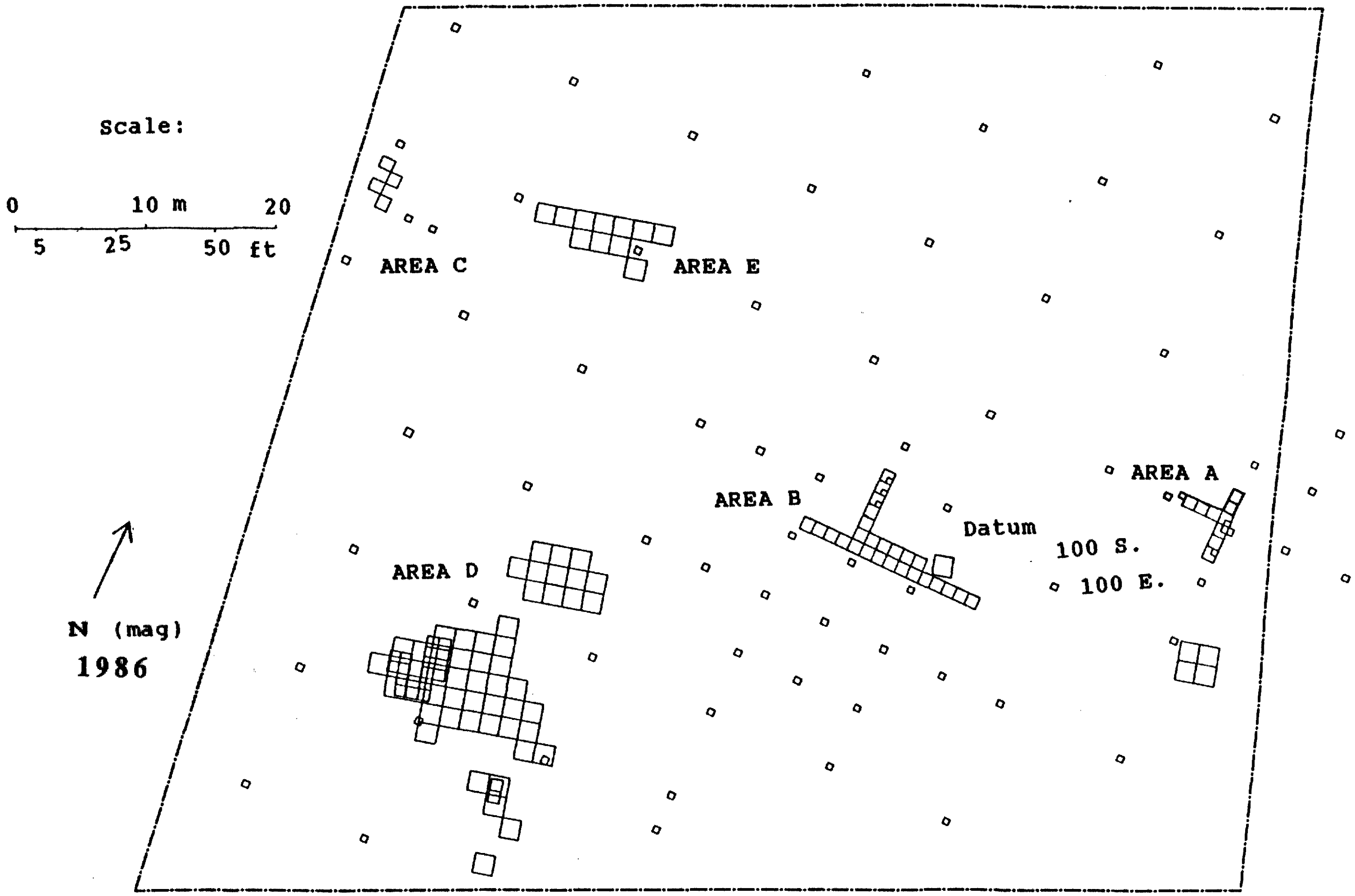


FIGURE 1.6: SURVEYING IN THE SITE (1960'S)

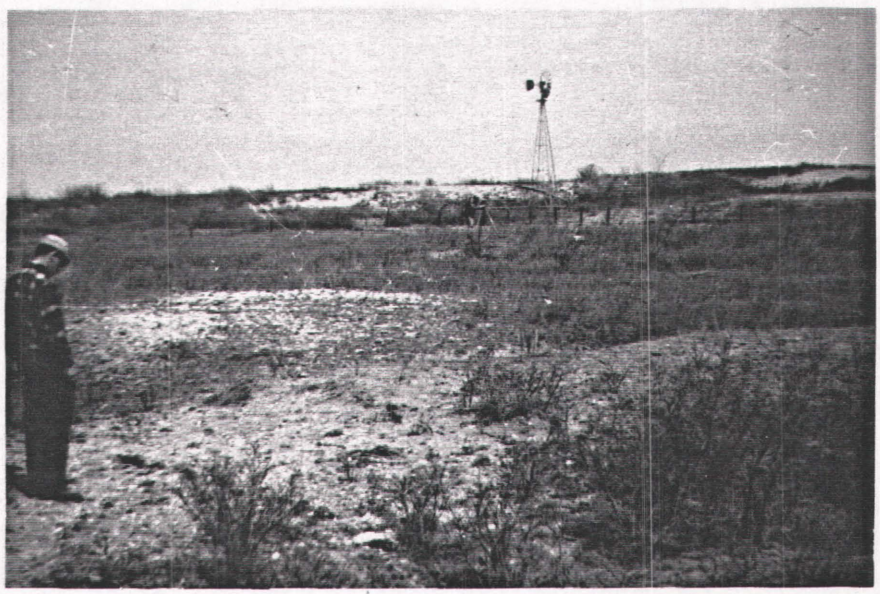
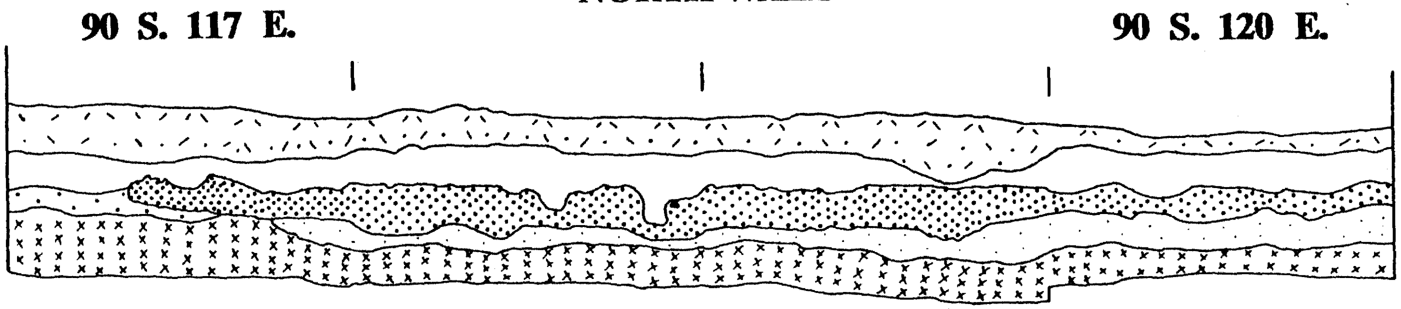


FIGURE 1.7: VIEW OF THE MELHAGEN SITE FROM THE TOP OF WINDMILL LOOKING SOUTHWEST

FIGURE 2.1

AREA A

NORTH WALL



1 m.

Backdirt	Stone Flakes
Sod	Bone
Aeolian Sand	Fire-Cracked Rock
Bone Bed	Root/Rodent Disturbance
Oxidized Sand	Alkaline Sand
	Black Silty Sand

FIGURE 2.2

AREA A

WEST WALL

93 S. 120 E.

88 S. 120 E.

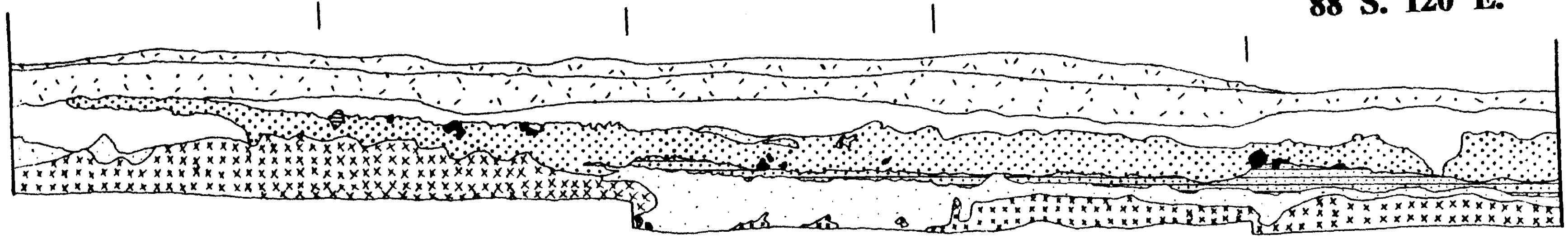


FIGURE 2.3

AREA B

SOUTH WALL

104 S. 105 E.

104 S. 102 E.

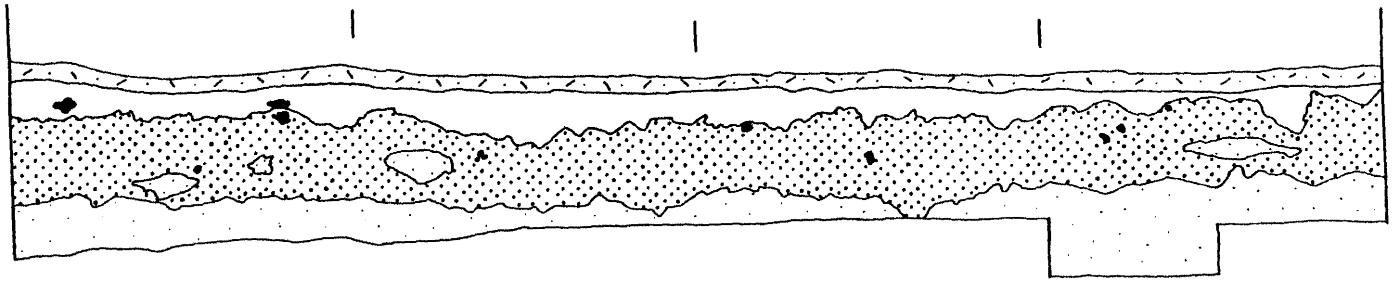


FIGURE 2.4

AREA B

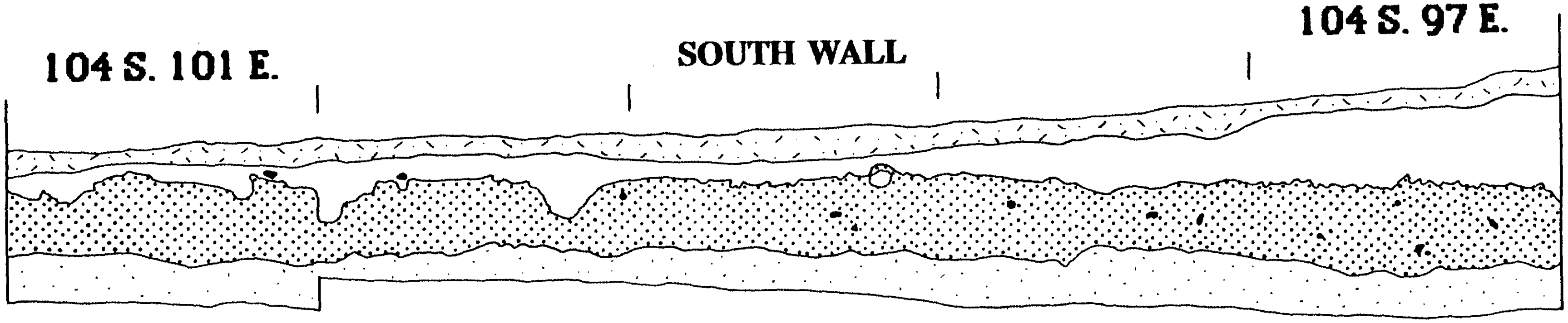


FIGURE 2.5

AREA B

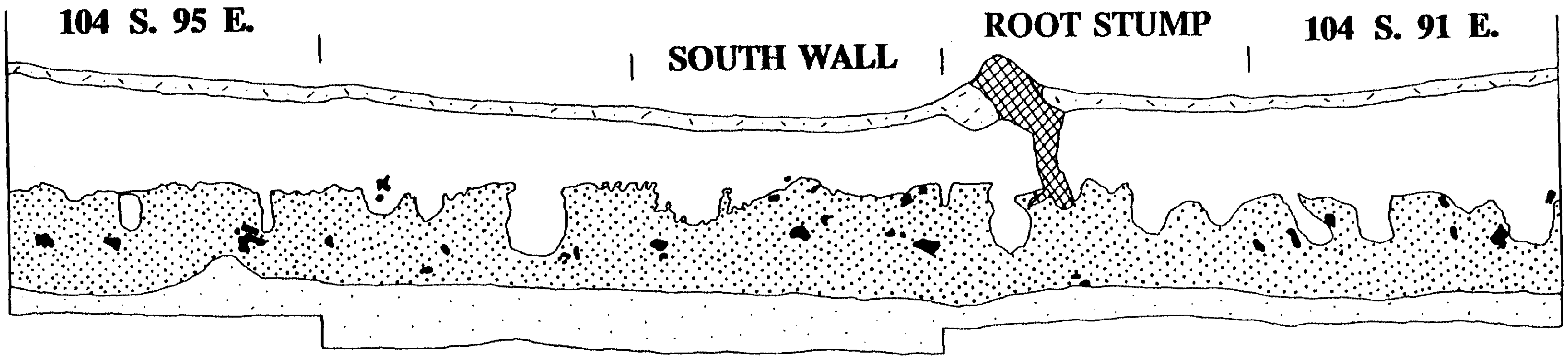


FIGURE 2.6

AREA B

WEST WALL

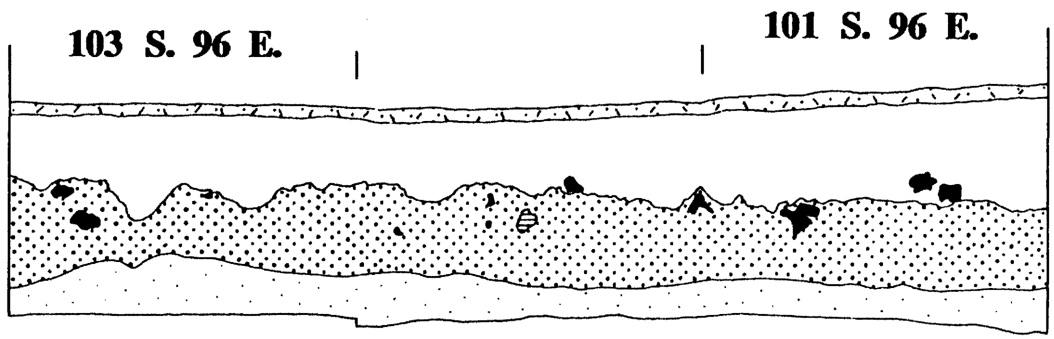


FIGURE 2.7

AREA B

WEST WALL

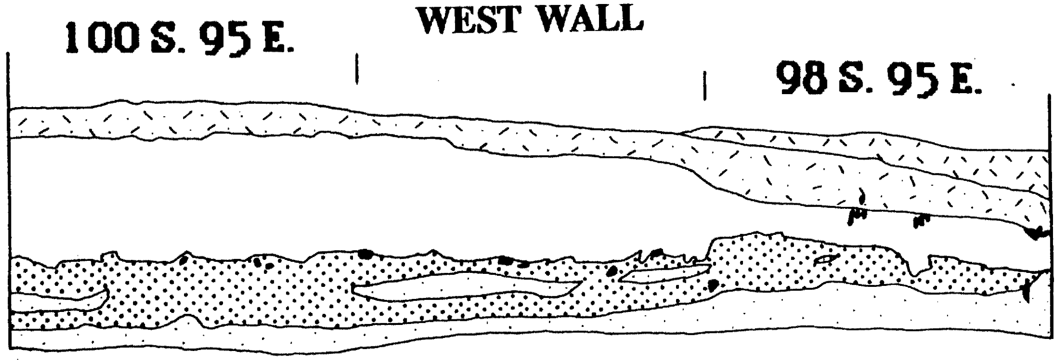


FIGURE 2.8

AREA C

NORTH WALL

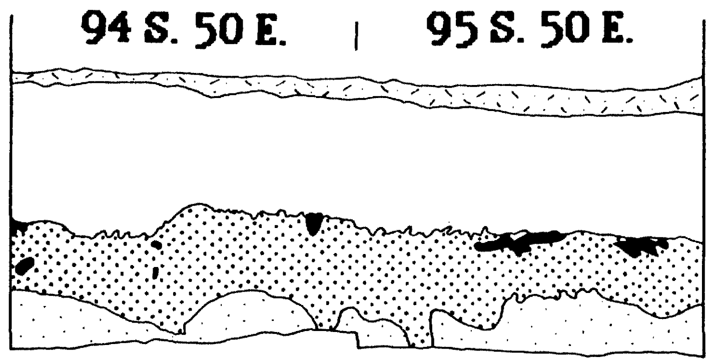


FIGURE 2.9

AREA C

WEST WALL

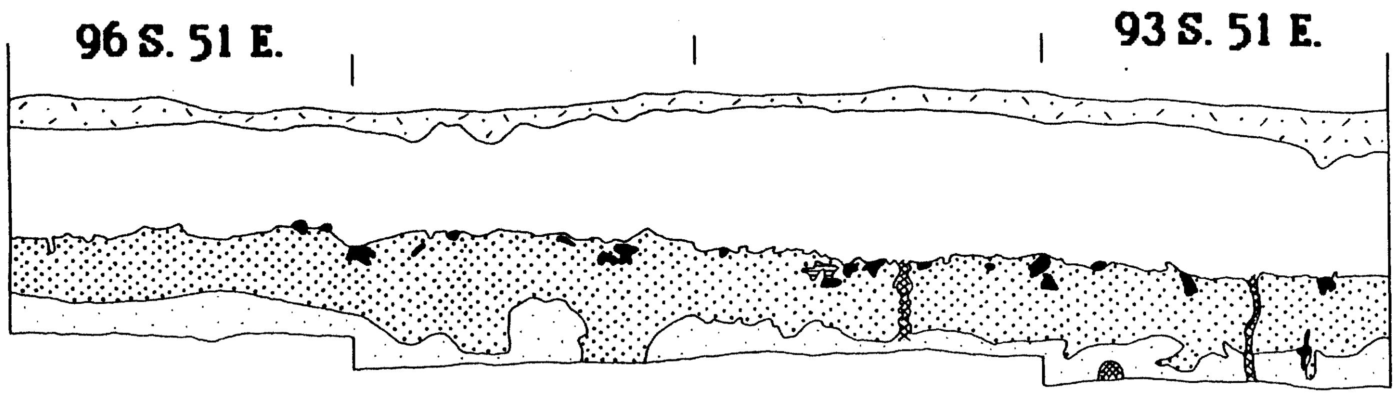


FIGURE 2.10

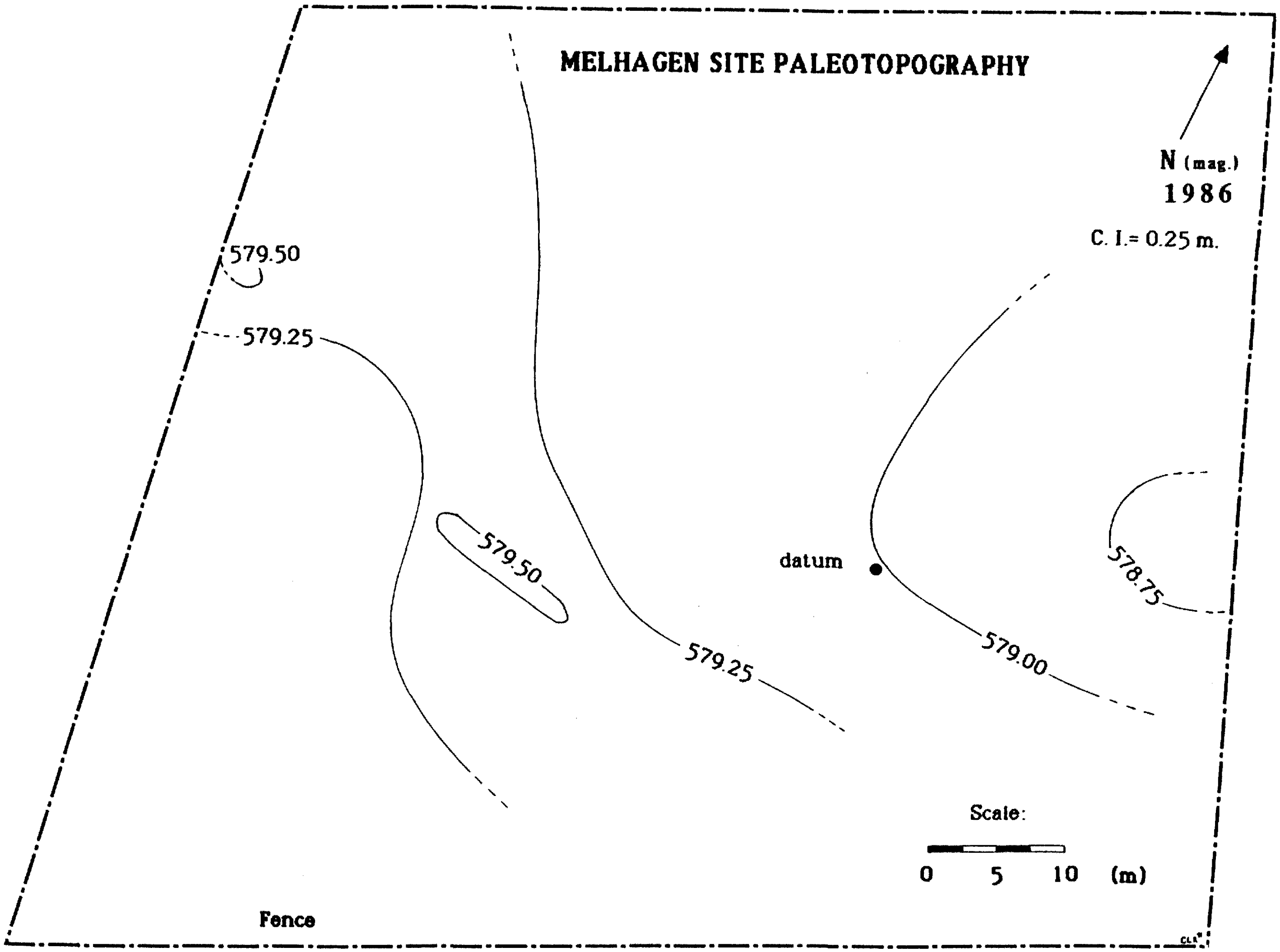

MELHAGEN SITE PALEOTOPOGRAPHY
N (mag.)
1986
C. I.= 0.25 m.
579.50
579.25
579.50
579.25
datum
579.00
578.75
Scale:
0 5 10 (m)
Fence

FIGURE 4.1 Melhagen Areal Survey

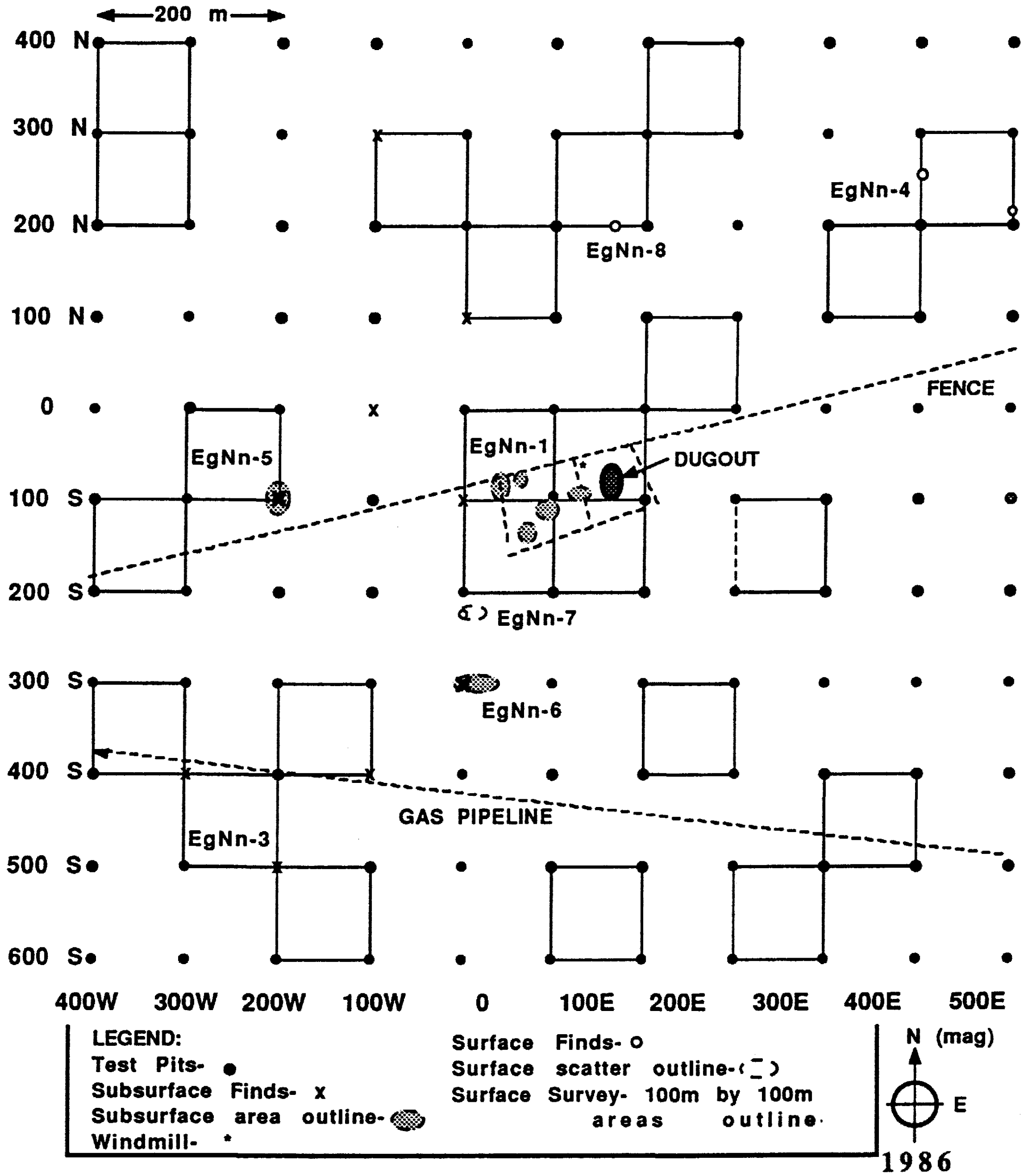


FIGURE 5.1: PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION PROJECTILE POINTS

All views are Dorsal unless stated otherwise


674


876


917


Ventral
928


1460


2242


2363


3021


3532

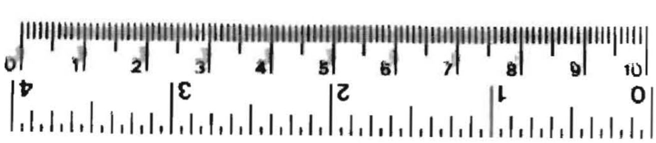
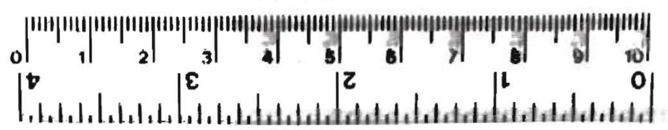


FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION PROJECTILE POINTS

3544 3588 3708

4469 4841 6307



PHENIX COLLECTION PROJECTILE POINTS

SAMANTHA?

10855 10856 10857

FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

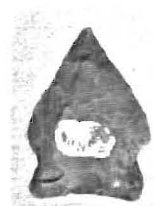
PHENIX COLLECTION PROJECTILE POINTS

SAMANTHA?
10858

10859

10860

10862



SAMANTHA?
10863

10864

10866

10869

10871

FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

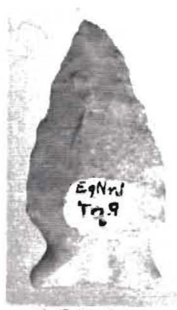
PHENIX COLLECTION PROJECTILE POINTS

SAMANTHA?
10873

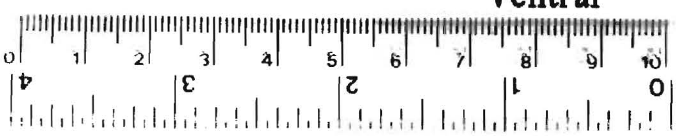
10875

10878

10884



10885
Ventral



SAMANTHA?
10886

10890

Photo
not
Available
See
Illustration

10891

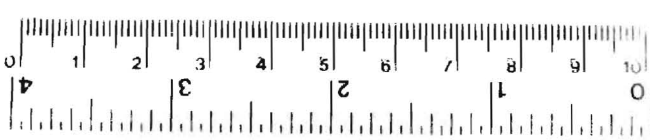


FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION KNIFE/ SPEARTIP

2973

PHENIX COLLECTION KNIFE/ SPEARTIPS

10861

10865

10867

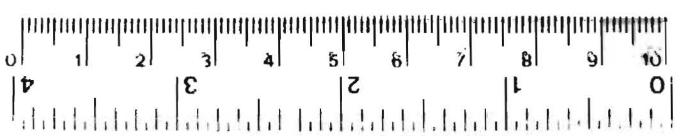


FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

PHENIX COLLECTION KNIFE/ SPEARTIPS

10868

10870

10874

10877

10881

10882

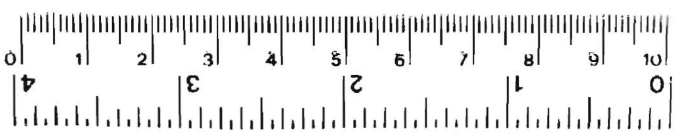
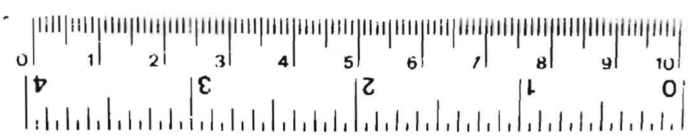


FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

PHENIX COLLECTION KNIFE/ SPEARTIPS

10883



PHENIX COLLECTION KNIFE/ SPEARTIPS

Photo not Available See Illustration

10887 10888 10889 10892

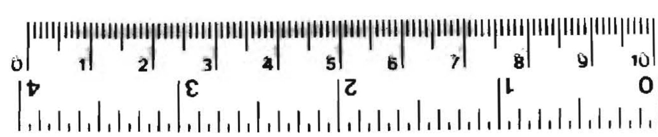


FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

PHENIX COLLECTION PROJECTILE POINTS

10893

10894

SAMANTHA?
10895

10896

10897

SAMANTHA?
10898

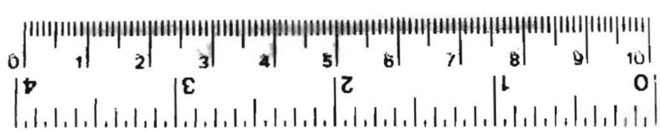
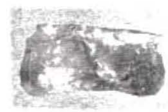


FIGURE 5.1 (Con't): PHOTOGRAPHS OF PROJECTILE POINTS RECOVERED FROM THE MELHAGEN SITE

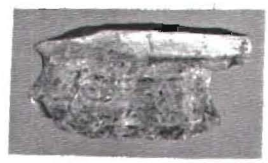
RAMSAY COLLECTION PROJECTILE POINT AND KNIFE BASES

3755



4171

6393



7204

PHENIX COLLECTION PROJECTILE POINT BASE

10183

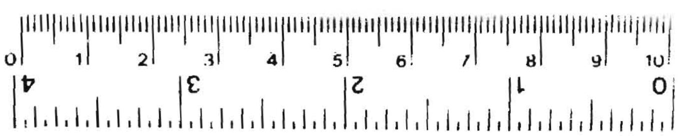
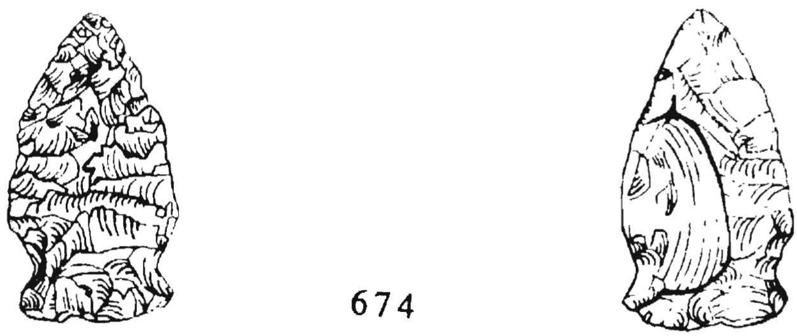


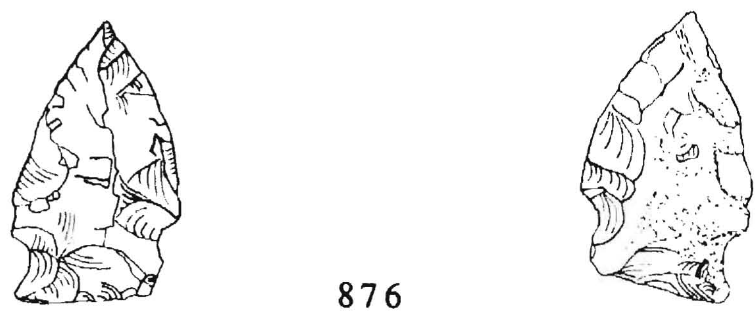
FIGURE 5.2: ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

RAMSAY COLLECTION PROJECTILE POINTS

Dorsal | Ventral



674



876

928

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

RAMSAY COLLECTION PROJECTILE POINTS

Dorsal | **Ventral**

1460

2242

2363

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

RAMSAY COLLECTION PROJECTILE POINTS

Dorsal **Ventral**

3021

3532

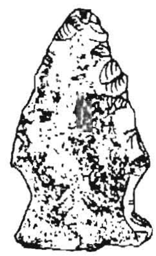
3544

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

RAMSAY COLLECTION PROJECTILE POINTS

Dorsal		Ventral

3588



3708

4469

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

RAMSAY COLLECTION PROJECTILE POINTS

Dorsal **Ventral**

4841

6307

PHENIX COLLECTION PROJECTILE POINTS

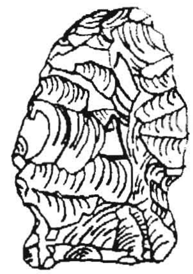
10855

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

Dorsal | **Ventral**

10856



SAMANTHA?
10857

SAMANTHA?
10858

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

Dorsal | Ventral

10859

10860

10862

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

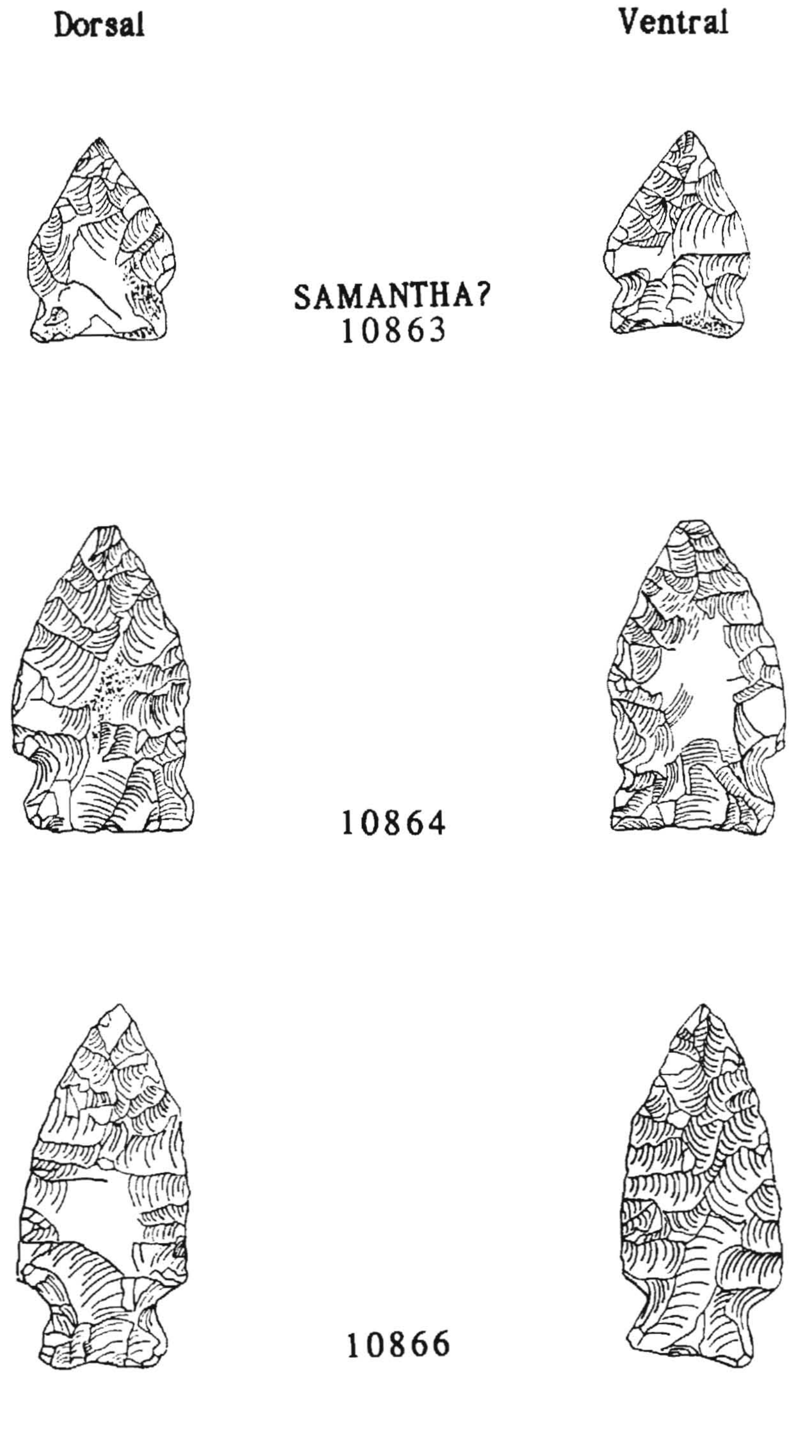
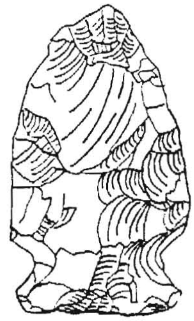


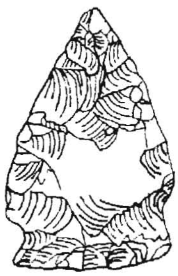
FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

Dorsal **Ventral**

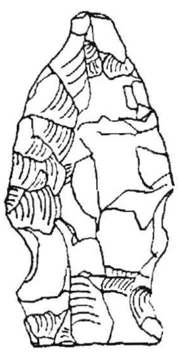
10869





10871

SAMANTHA?
10873



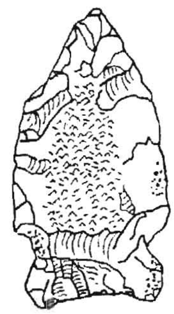
10875

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

Dorsal | Ventral

10878



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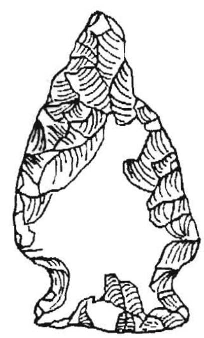

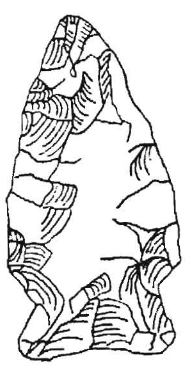

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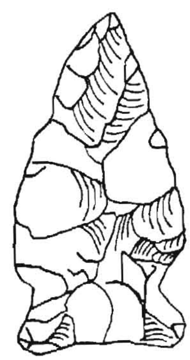

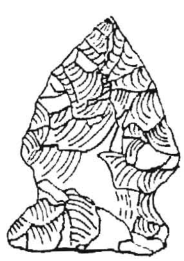

SAMANTHA?
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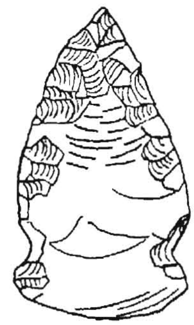
FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

Dorsal **Ventral**

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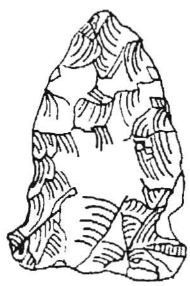



10891


10893

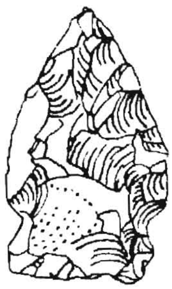

10894

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION PROJECTILE POINTS

Dorsal | Ventral

SAMANTHA?
10895



10896

10897

SAMANTHA?
10898

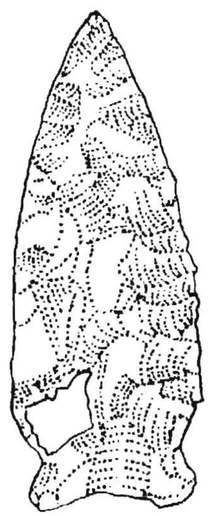
FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

RAMSAY COLLECTION KNIFE/ SPEARTIP

Dorsal

Ventral

2973



PHENIX COLLECTION KNIFE/ SPEARTIPS

10861

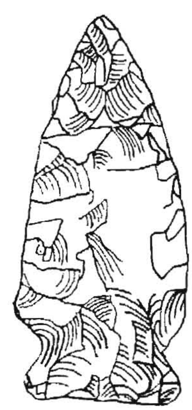


FIGURE 5.2: ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION KNIFE/ SPEARTIPS

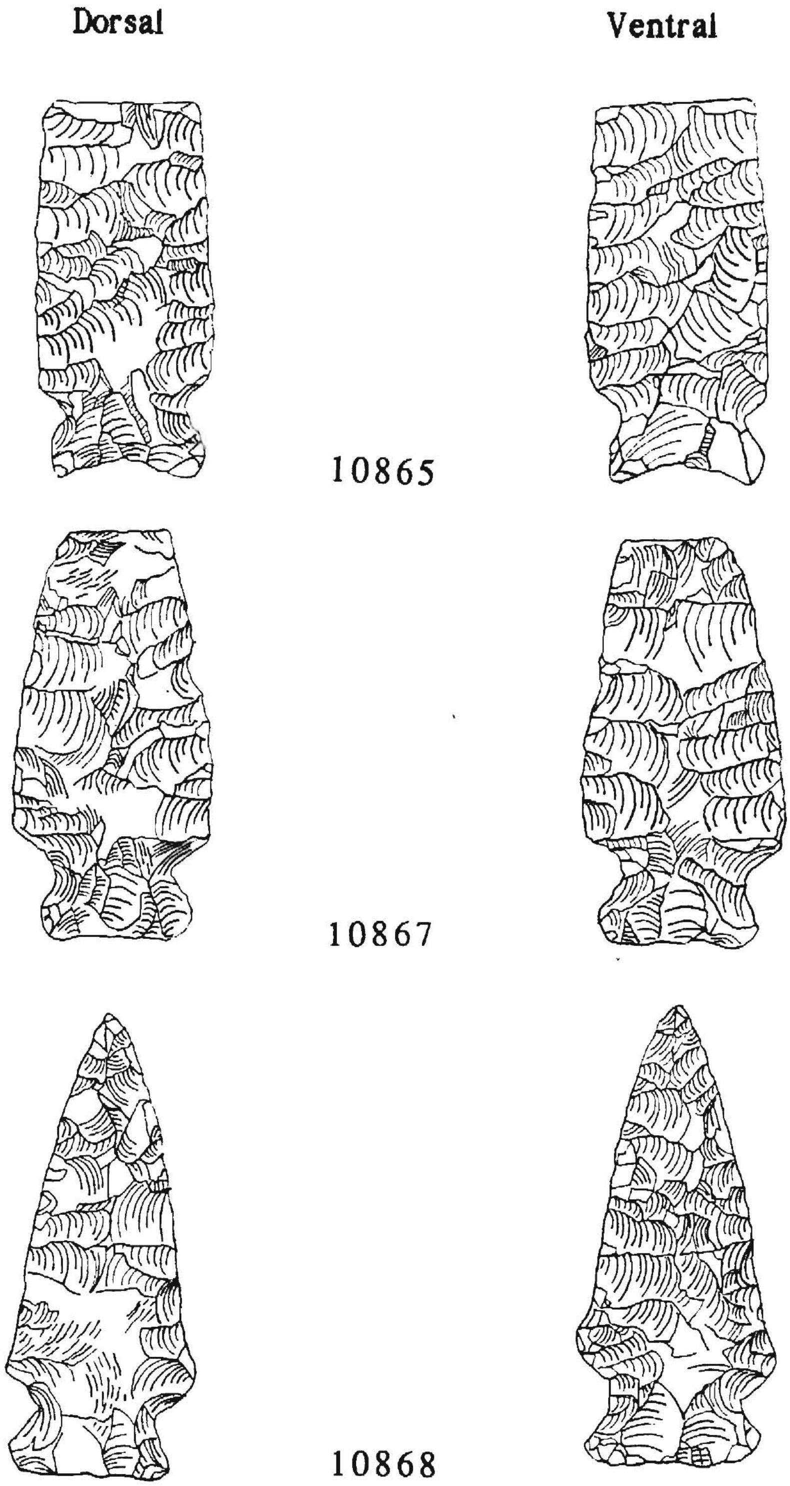
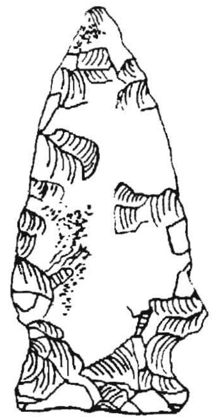


FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION KNIFE/ SPEARTIPS

Dorsal		Ventral

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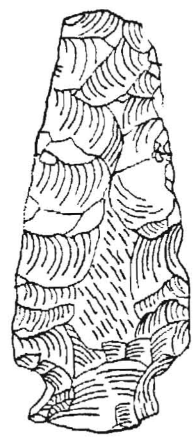


10874

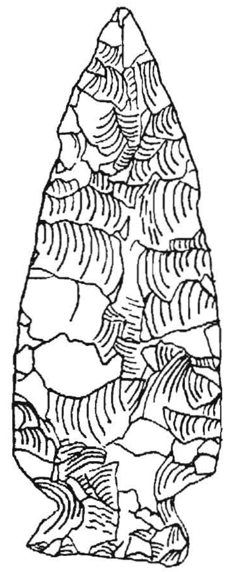

10877

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION KNIFE/ SPEARTIPS

Dorsal

Ventral



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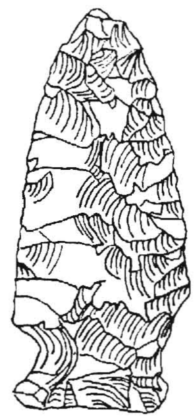

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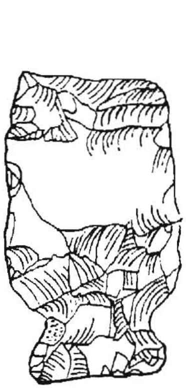
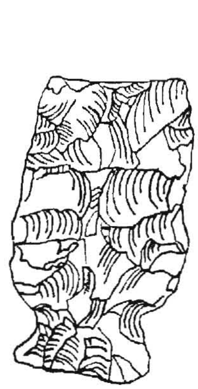




10883

FIGURE 5.2 (Con't): ILLUSTRATIONS OF MELHAGEN SITE PROJECTILE POINTS

PHENIX COLLECTION KNIFE/ SPEARTIPS

Dorsal **Ventral**

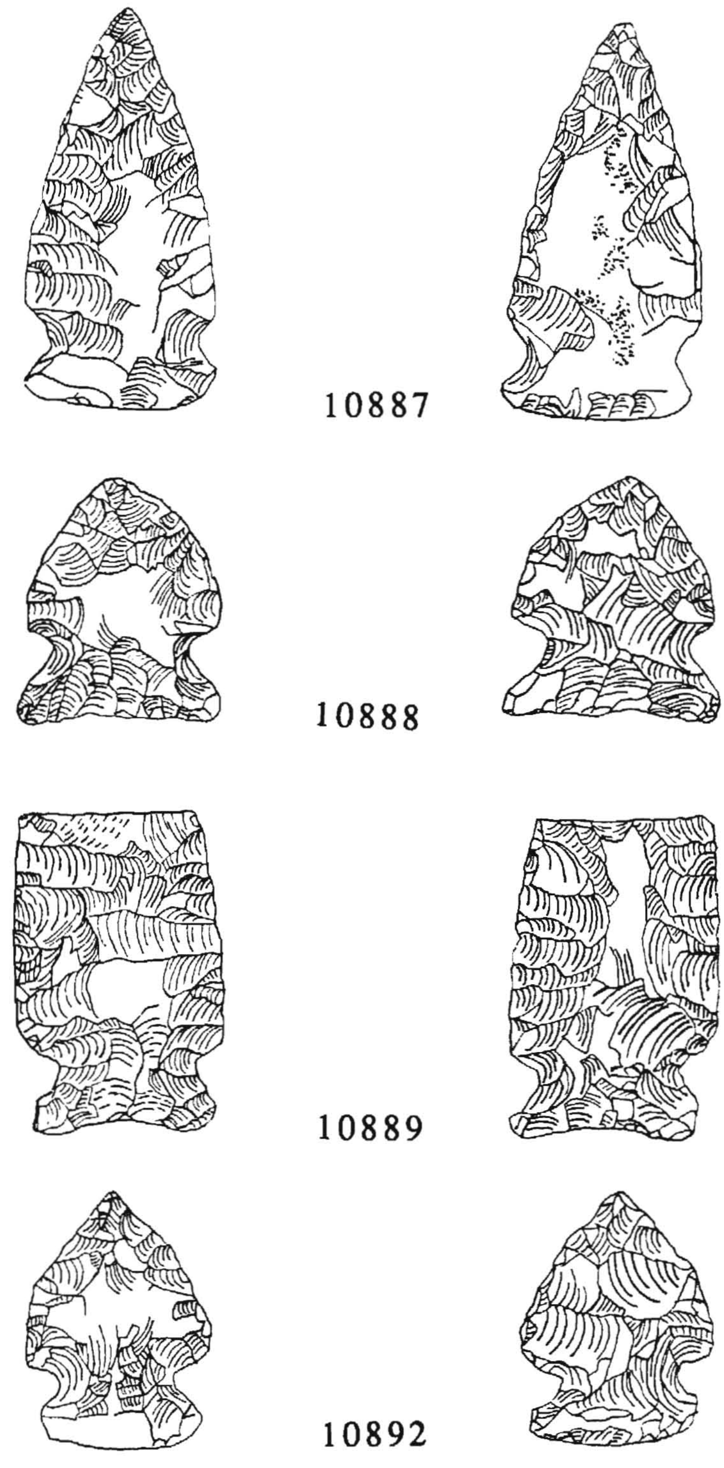
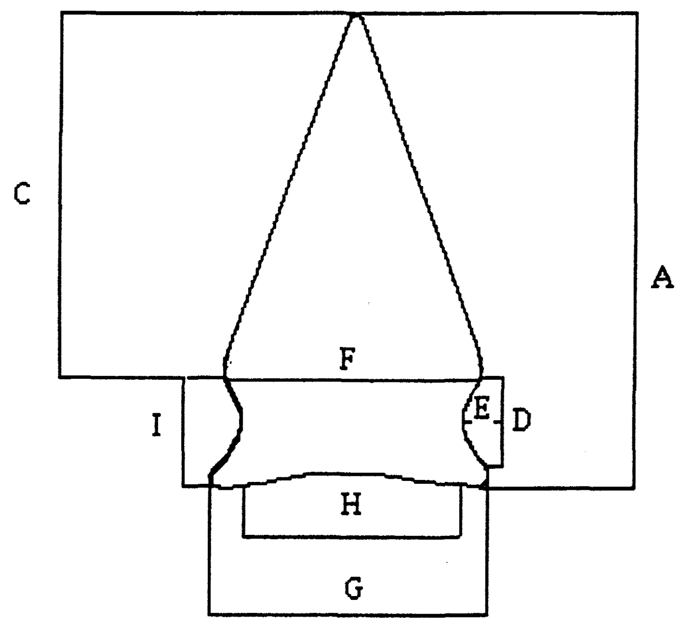


FIGURE 5.3:

MEASUREMENTS USED IN PROJECTILE POINT ANALYSIS



A) Maximum Length

B) Maximum Thickness

C) Body Length (L & R)

D) Notch Height (L & R)

E) Notch Depth (L & R)

F) Shoulder Width ⎤ Either F) or G)

G) Maximum Base Width (L & R). ⎦ = Max. Width

H) Neck Width (Minimum)

I) Basal Height (L & R)

FIGURE 5.4: COMPONENT 1 * COMPONENT 2: BY COLLECTION

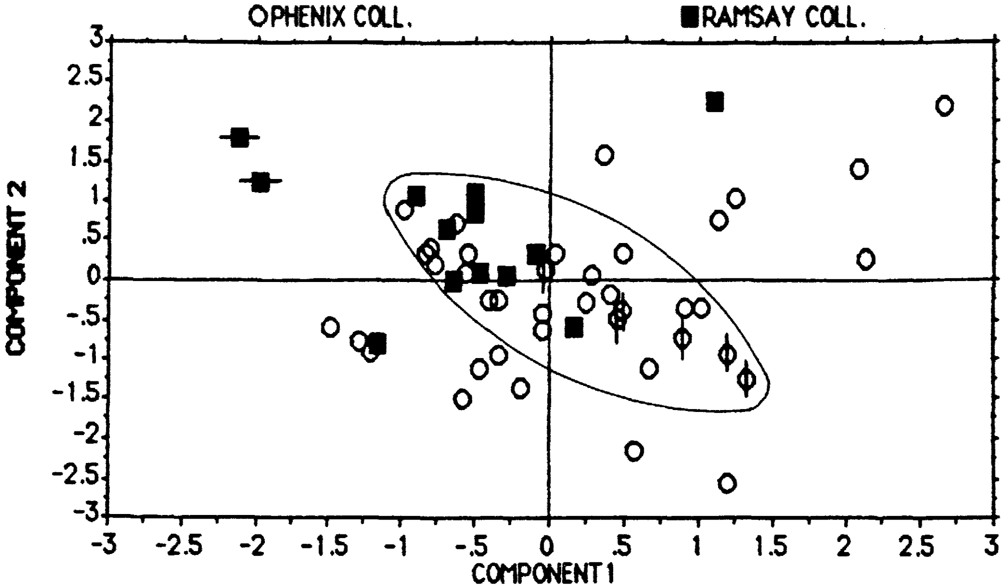
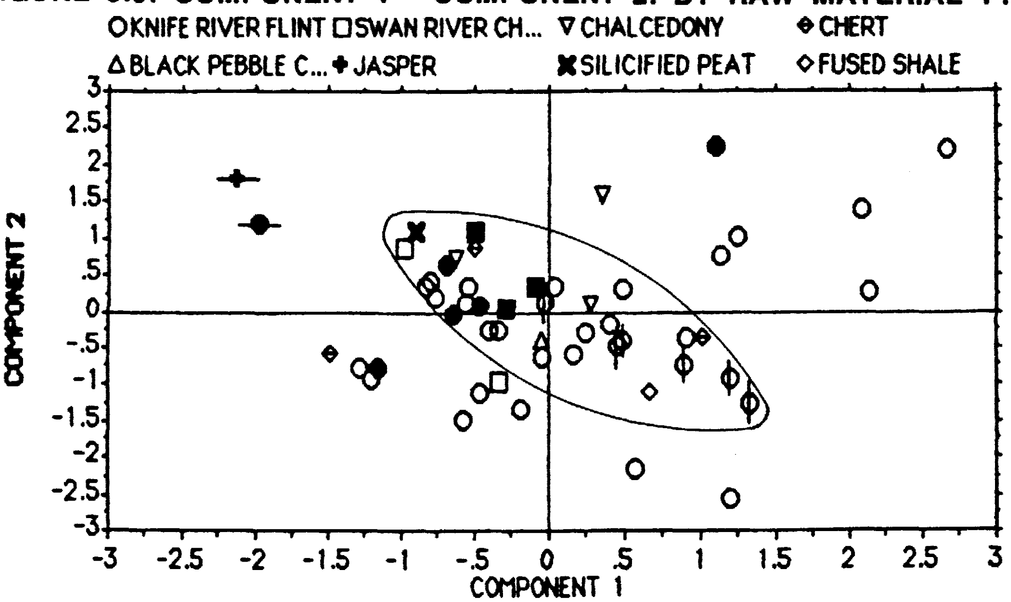


FIGURE 5.5: COMPONENT 1 * COMPONENT 2: BY RAW MATERIAL TYPE



* Note: Solid symbols denote Ramsay collection

etc.: Denote artifacts where substituted mean value for maximum length is much < actual broken measurement

etc.: Denote artifacts where substituted mean value for maximum length is much > actual broken measurement

FIGURE 5.6: COMPONENT 1 * COMPONENT 2: BY PATINATION

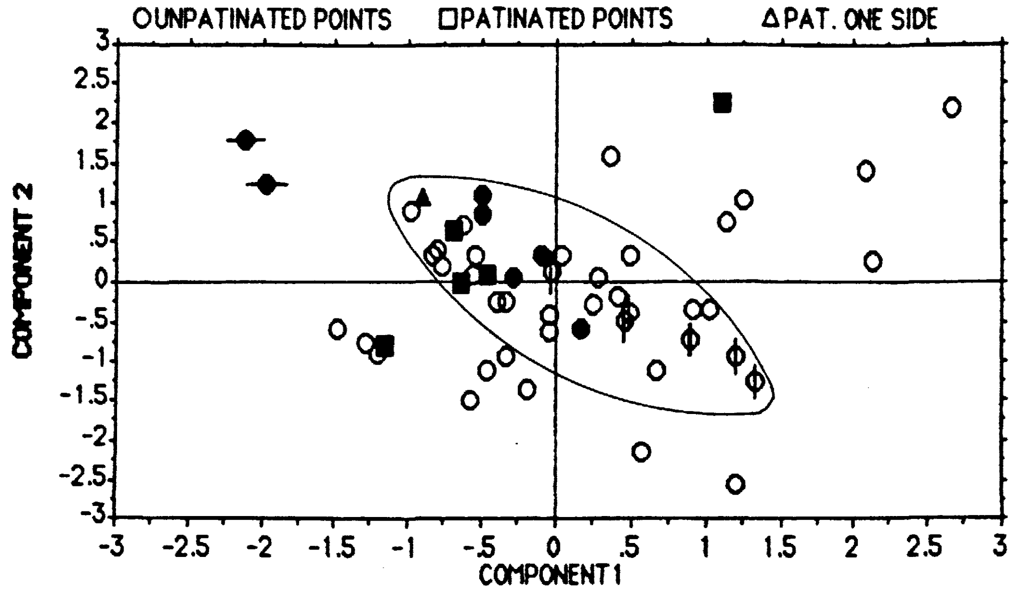
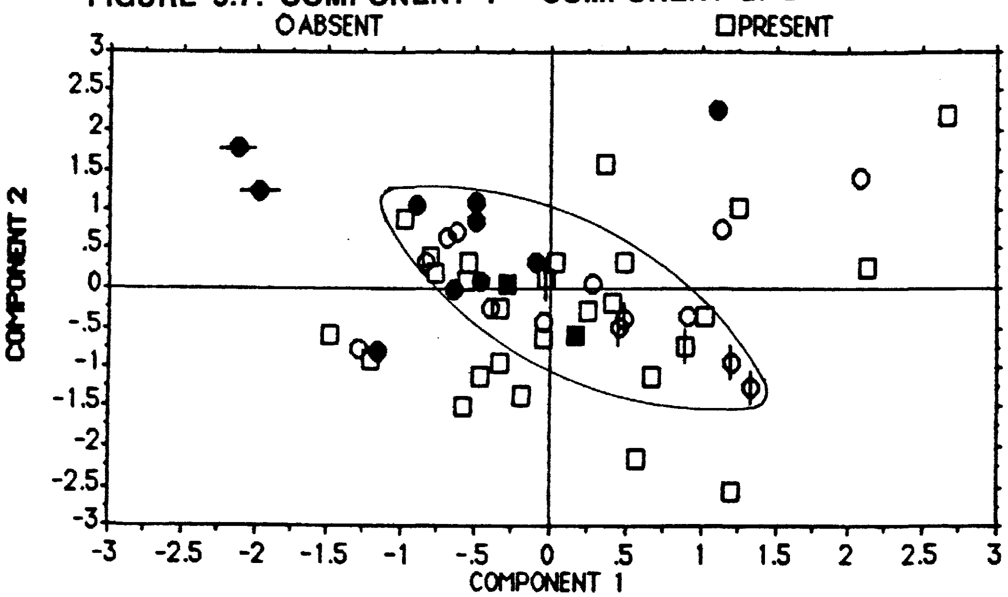


FIGURE 5.7: COMPONENT 1 * COMPONENT 2: BY REWORKING



* Note: Solid symbols denote Ramsay collection

ϕ, etc.: Denote artifacts where substituted mean value for maximum length is much < actual broken measurement

θ, etc.: Denote artifacts where substituted mean value for maximum length is much > actual broken measurement

FIGURE 5.8: COMPONENT 2 * COMPONENT 3: BY COLLECTION

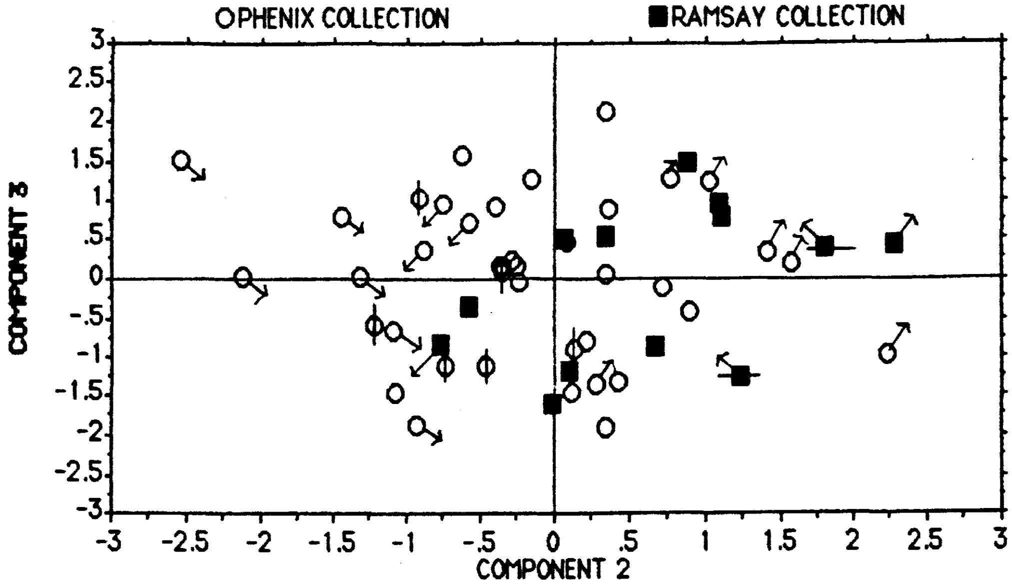
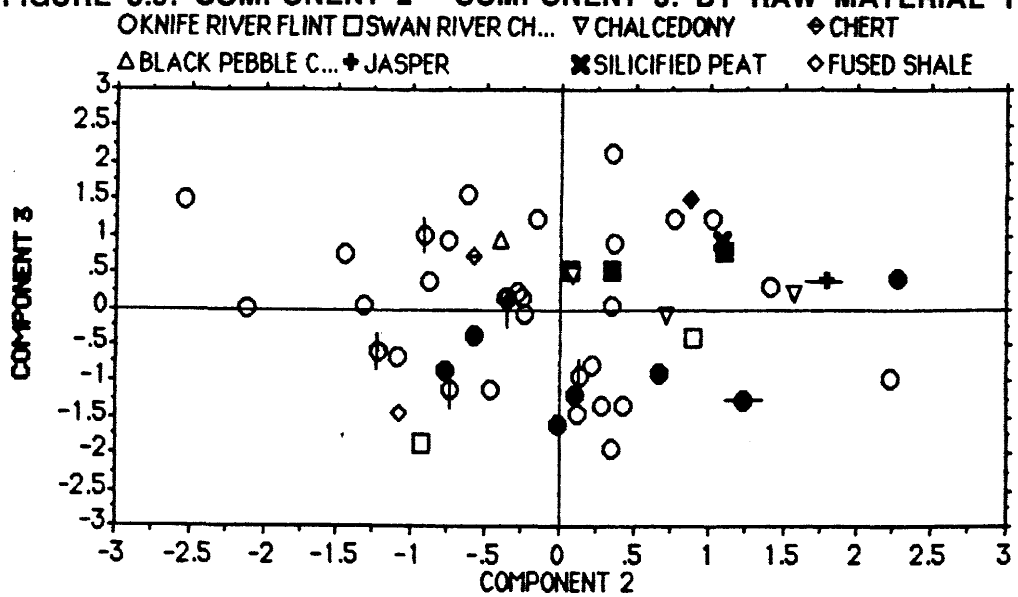


FIGURE 5.9: COMPONENT 2 * COMPONENT 3: BY RAW MATERIAL TYPE

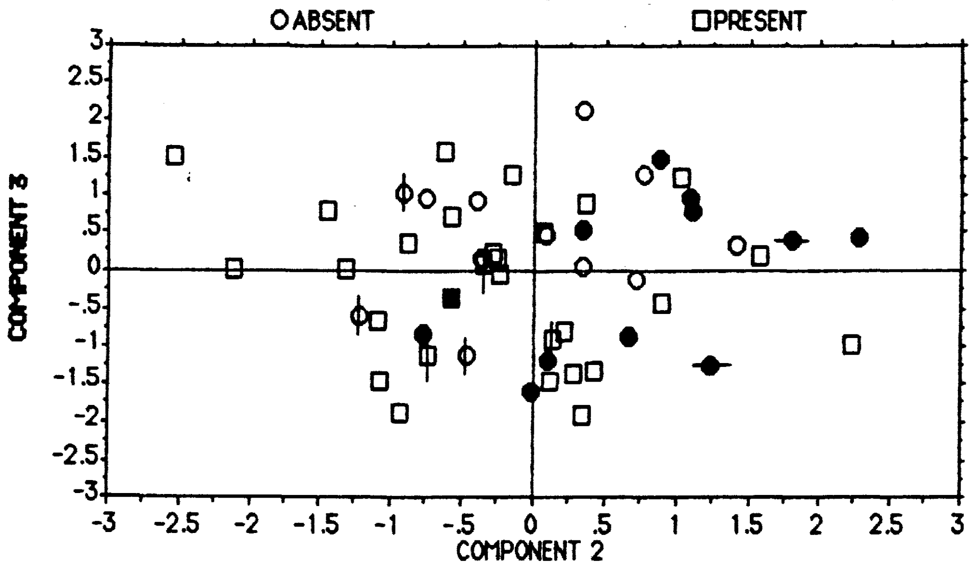


* Note: Solid symbols denote Ramsay collection

ϕ, etc.: Denote artifacts where substituted mean value for maximum length is much < actual broken measurement

θ, etc.: Denote artifacts where substituted mean value for maximum length is much > actual broken measurement

FIGURE 5.10: COMPONENT 2 * COMPONENT 3: BY REWORKING



* Note: Solid symbols denote Ramsay collection

□ ϕ, etc.: Denote artifacts where substituted mean value for maximum length is much < actual broken measurement

⊟ θ, etc.: Denote artifacts where substituted mean value for maximum length is much > actual broken measurement

FIGURE 5.11: EgNn-1 Radiocarbon Dates (in RCY B.P.)

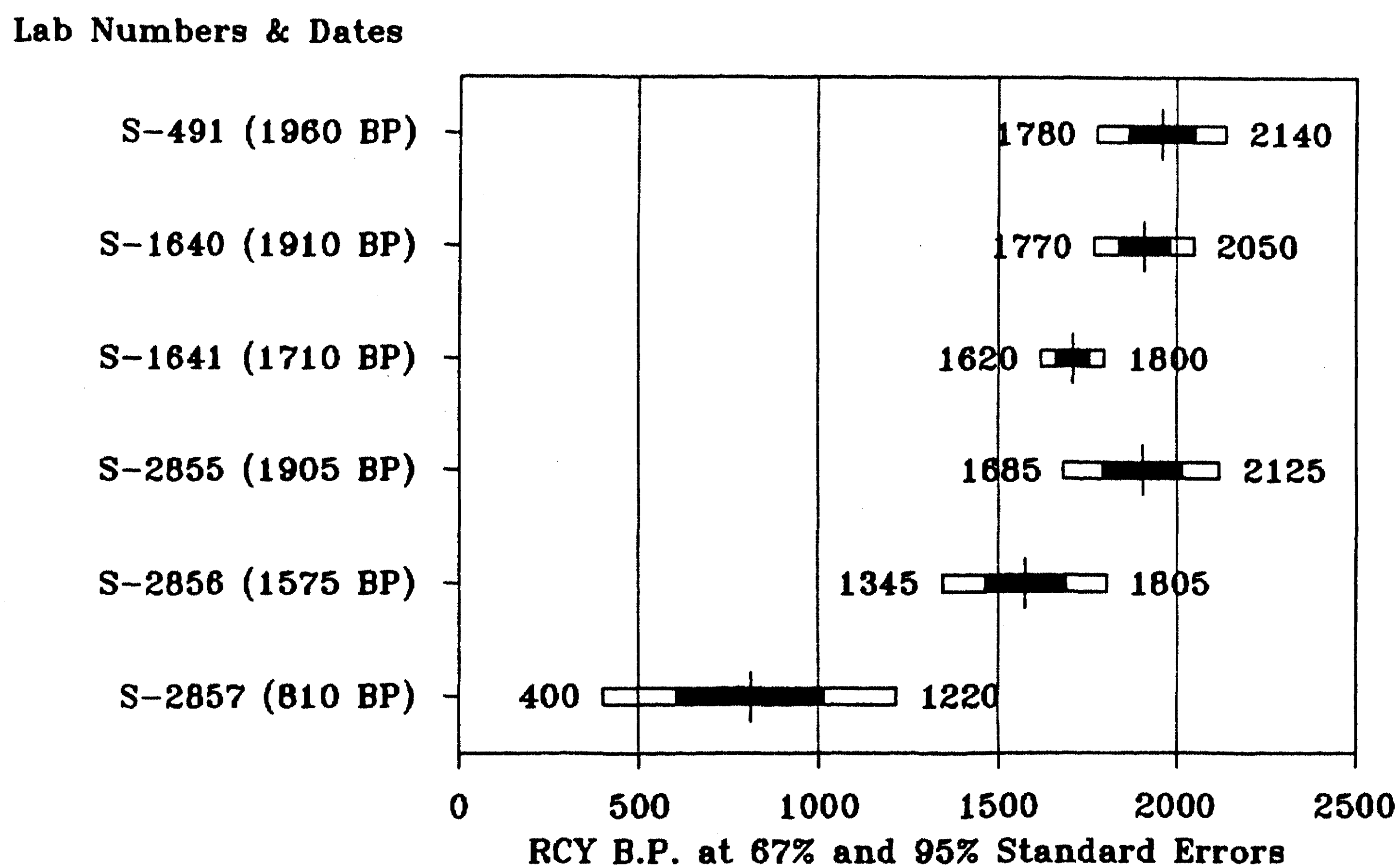


FIGURE 6.1:
AGE PROFILE INCLUDING ALL MANDIBLES IN YEAR GROUPS

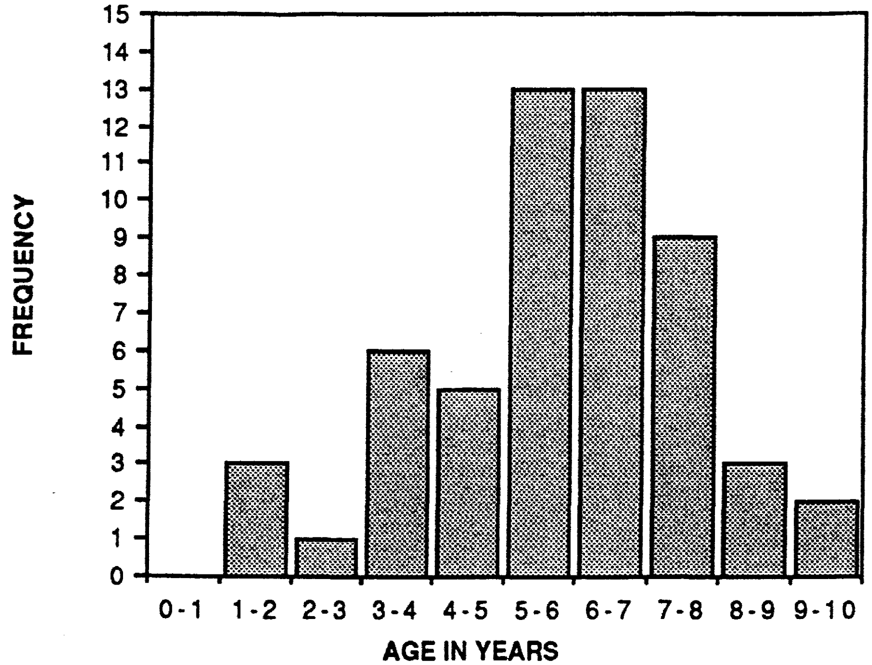


FIGURE 6.2: KILL EVENT SEASONS OF ALL MANDIBLES WITH KNOWN PROVENIENCE

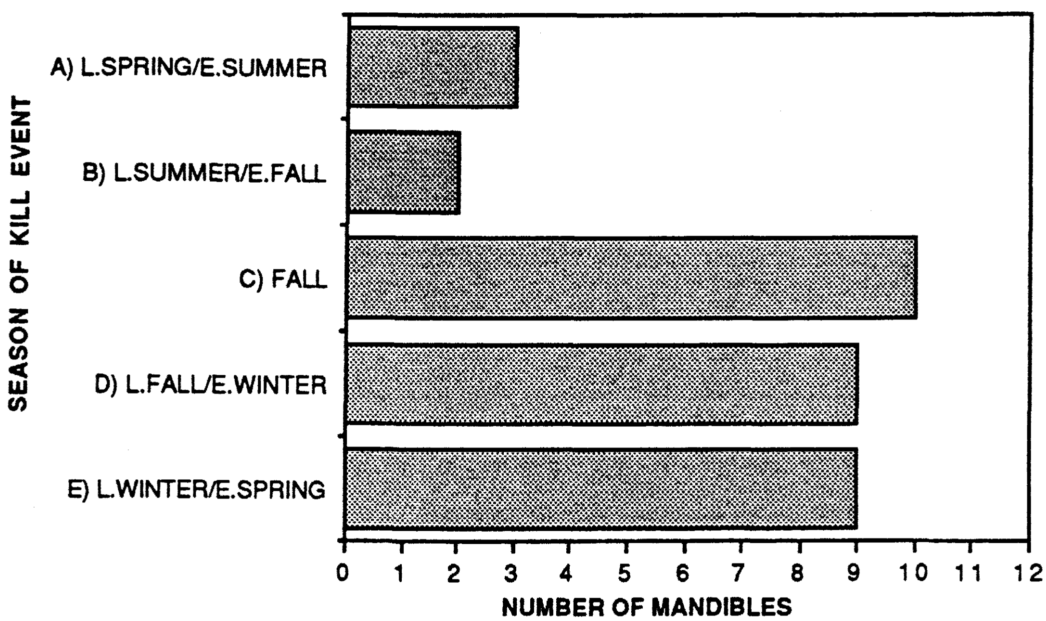


FIGURE 6.3:
KILL EVENT SEASONS IN AREA "B": CENTRAL TRENCH

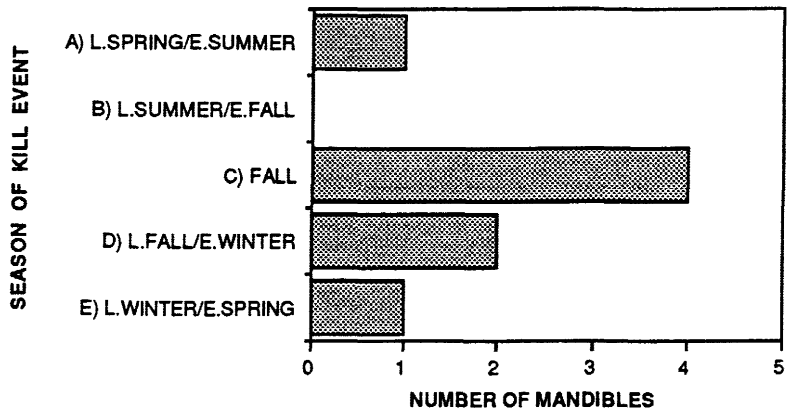


FIGURE 6.4:
KILL EVENT SEASONS IN AREA "C": WEST SIDE

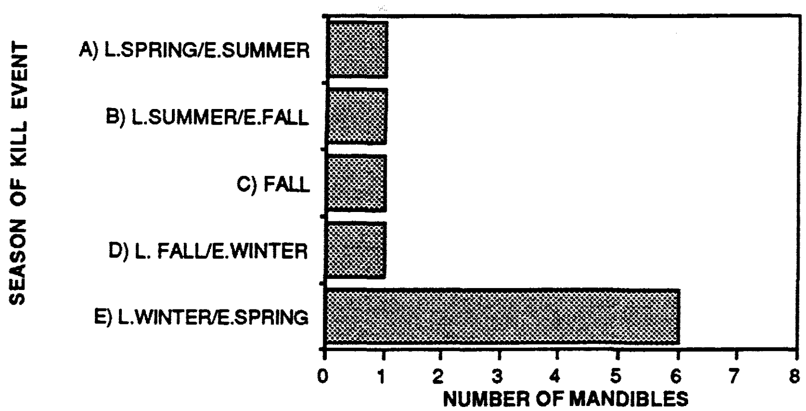


FIGURE 6.5:
KILL EVENT SEASONS IN AREA "D": SW PHENIX BLOCKS

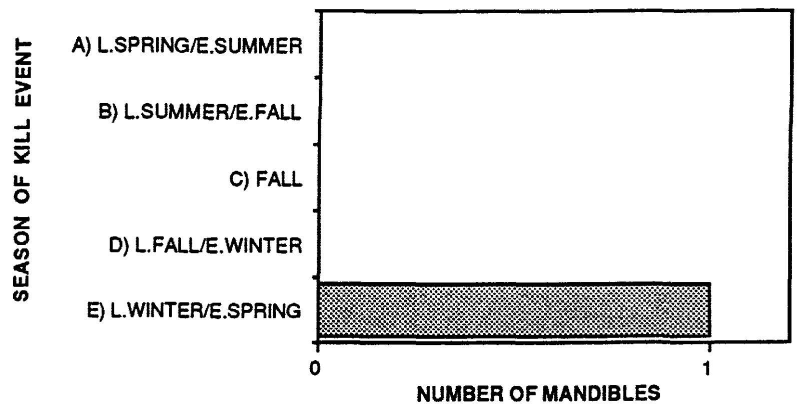


FIGURE 6.6:
KILL EVENT SEASONS IN AREA "E": NW PHENIX TRENCH

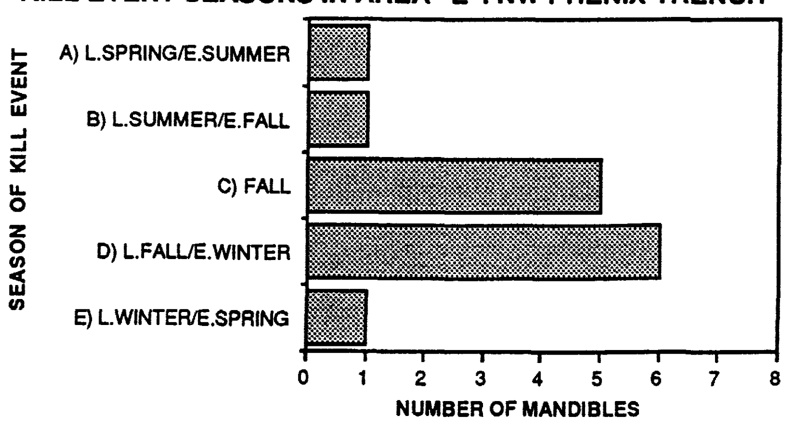


FIGURE 6.7: DISTRIBUTION OF MALES AND FEMALES USING FRONT FIRST PHALANGES (ROBERTS 1982)

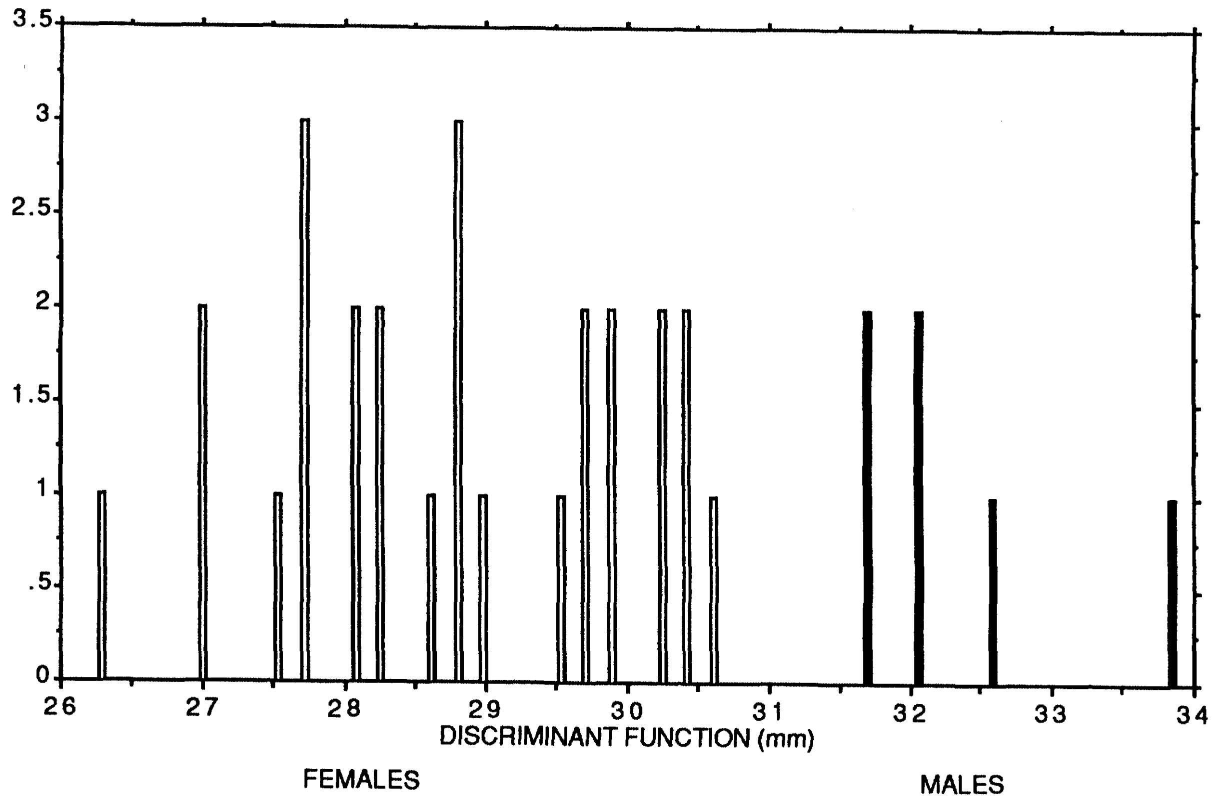


FIGURE 6.8: GENDER DETERMINATION FROM COMPLETE METACARPALS (Bedord 1974; 1978)

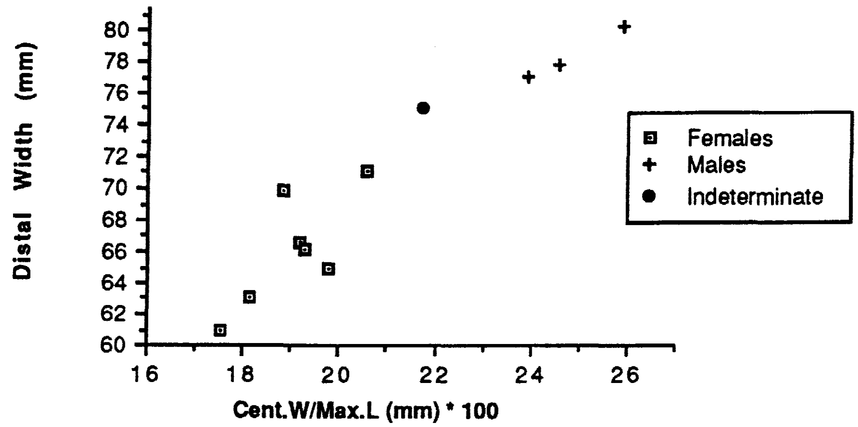


FIGURE 6.9: GENDER DETERMINATION FROM COMPLETE METATARSALS (Bedord 1974; 1978)

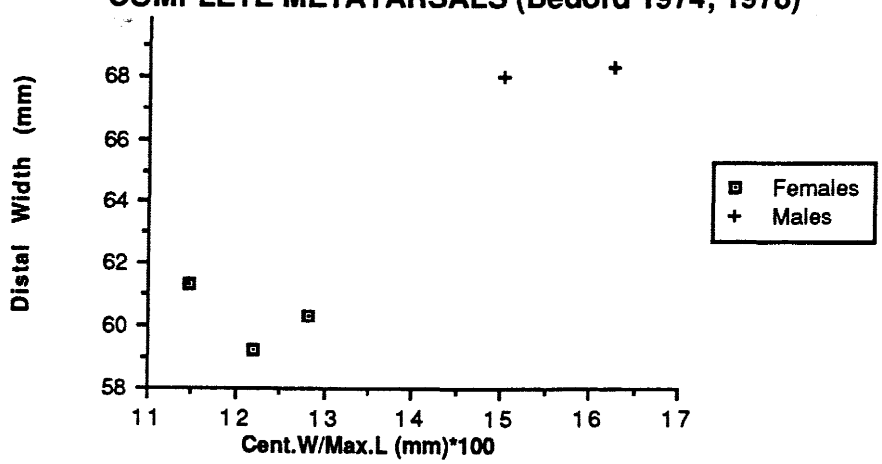


FIGURE 7.1:
RELATIONSHIP BETWEEN%MNE AND MGUI
(Binford 1978: Table 2.7 col. 1)

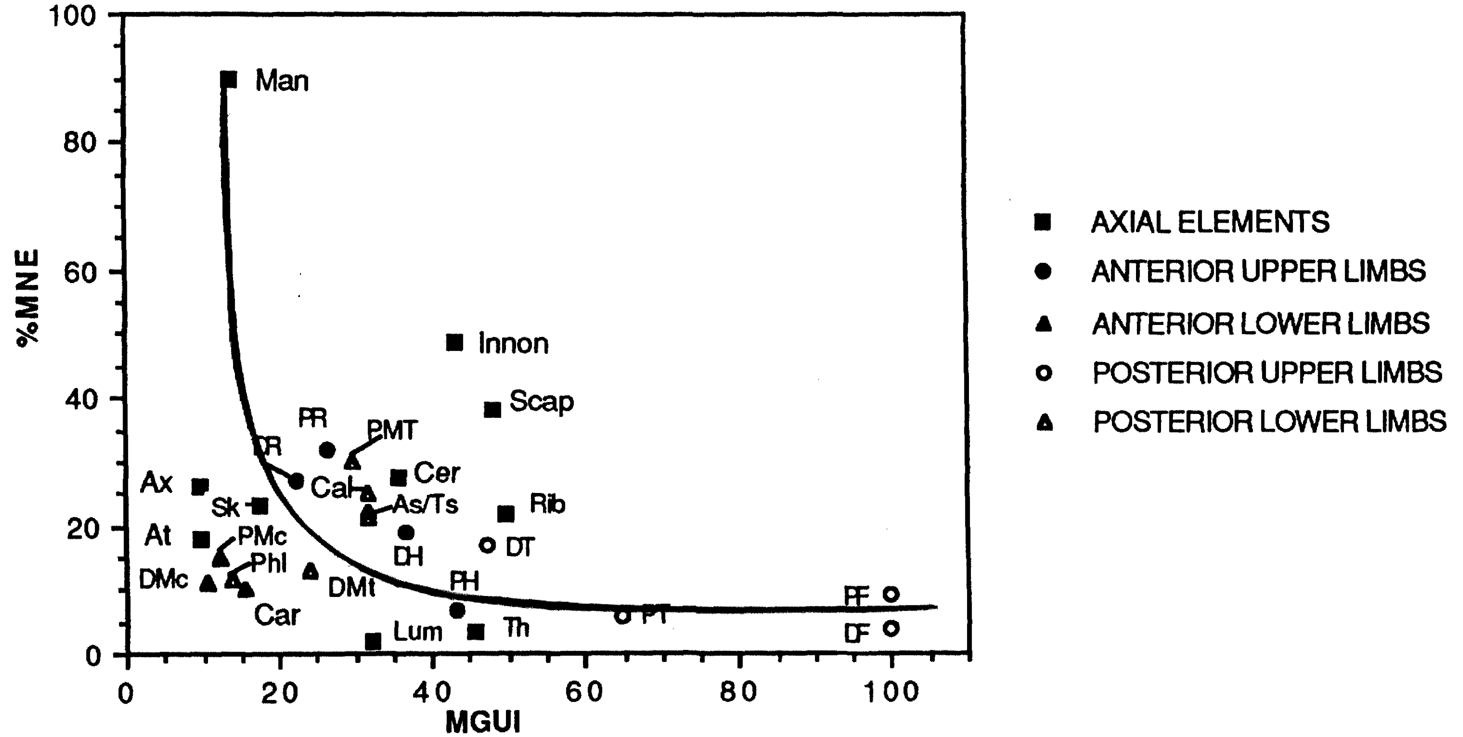


FIGURE 7.2: DENSITY (Grams) OF FAUNAL MATERIALS PER 50 cm TEST PIT ON A 10 m. GRID

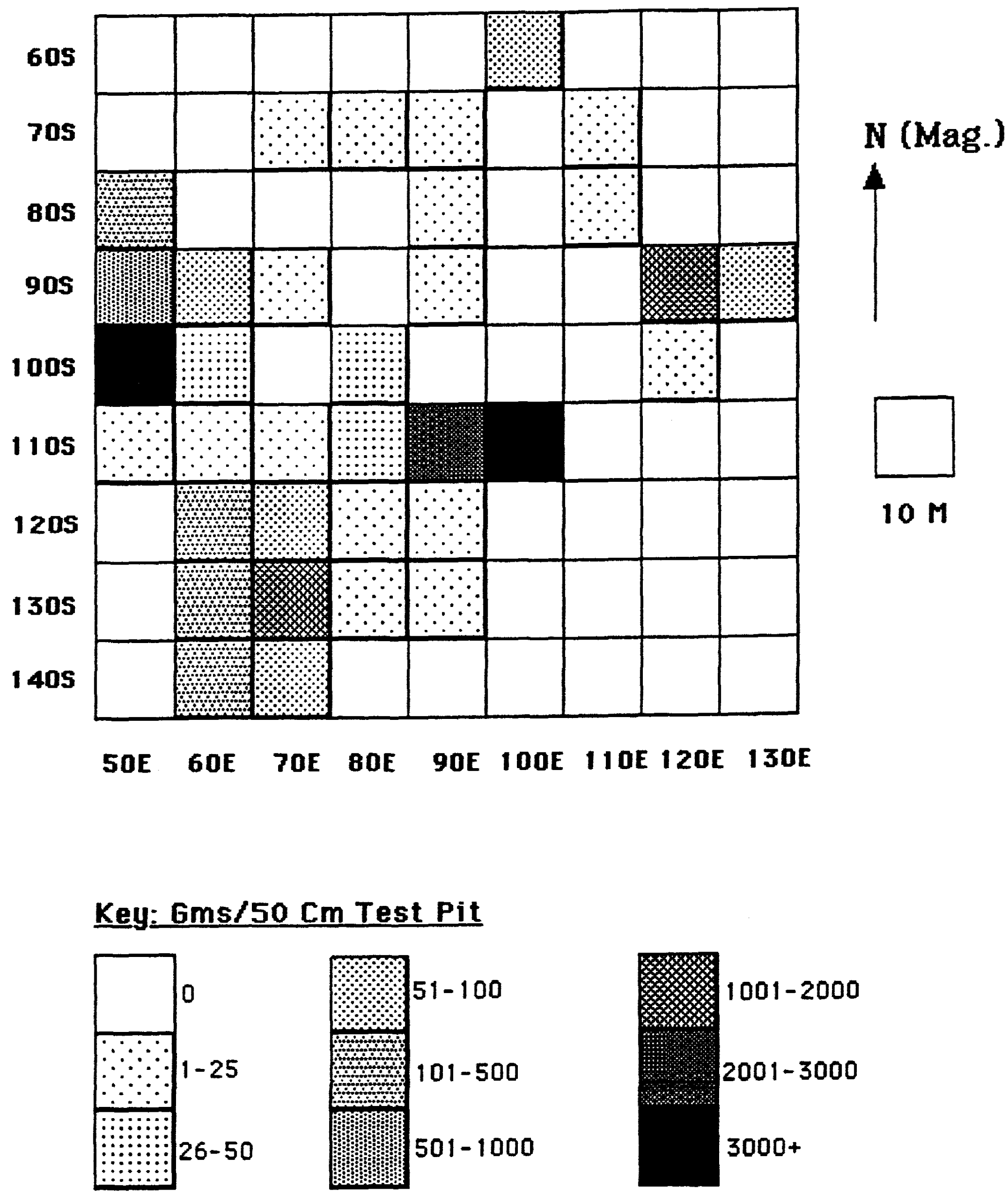


FIGURE 7.3: DENSITY (Grams/Frag.) OF FAUNAL MATERIALS PER 50 cm TEST PIT ON A 10 m. GRID

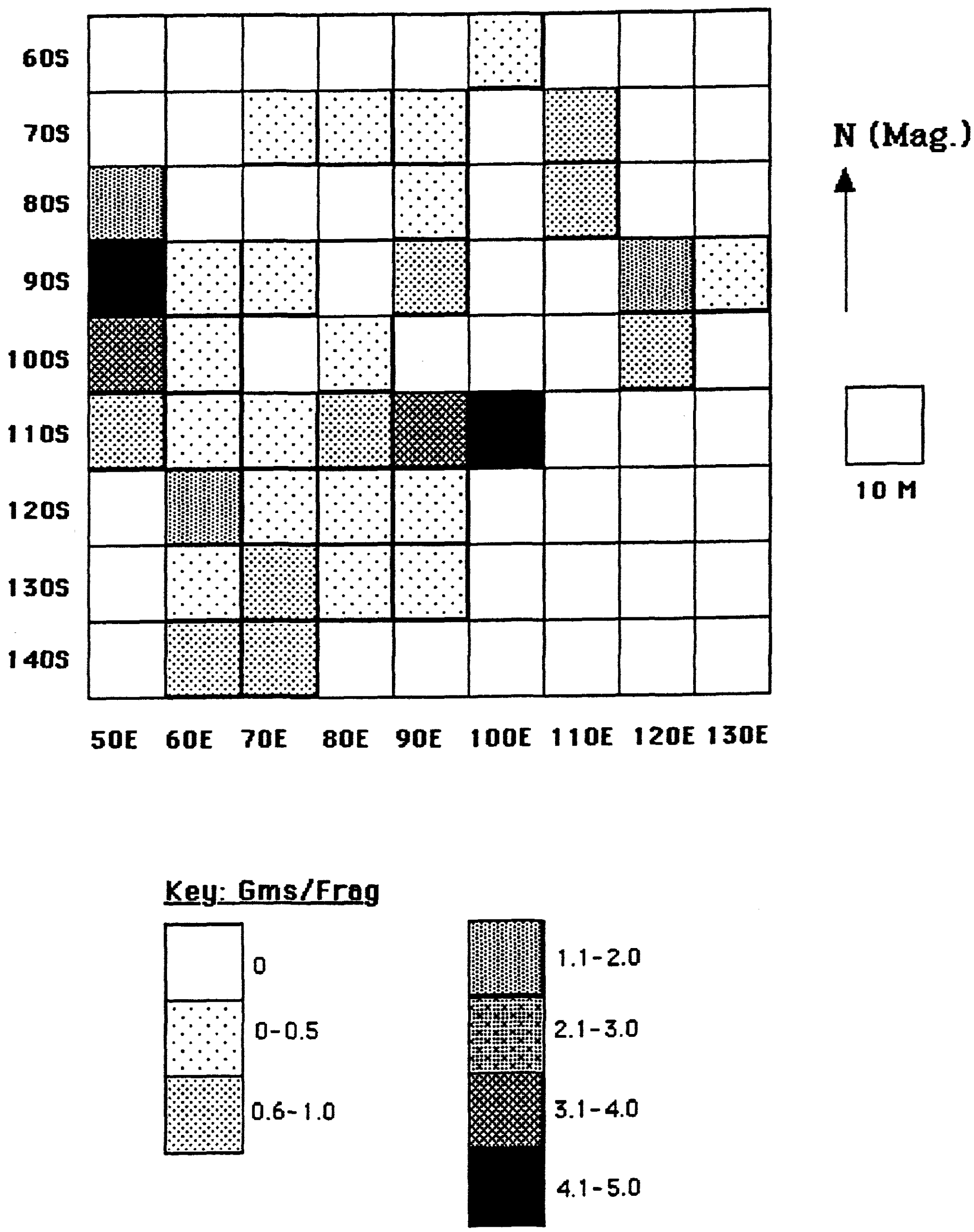


FIGURE 7.4: DENSITY (Grams) OF BURNED MATERILS (INCLUDING FCR & BURNED FAUNAL MATERIALS) PER 50 cm TEST PIT ON A 10 m GRID

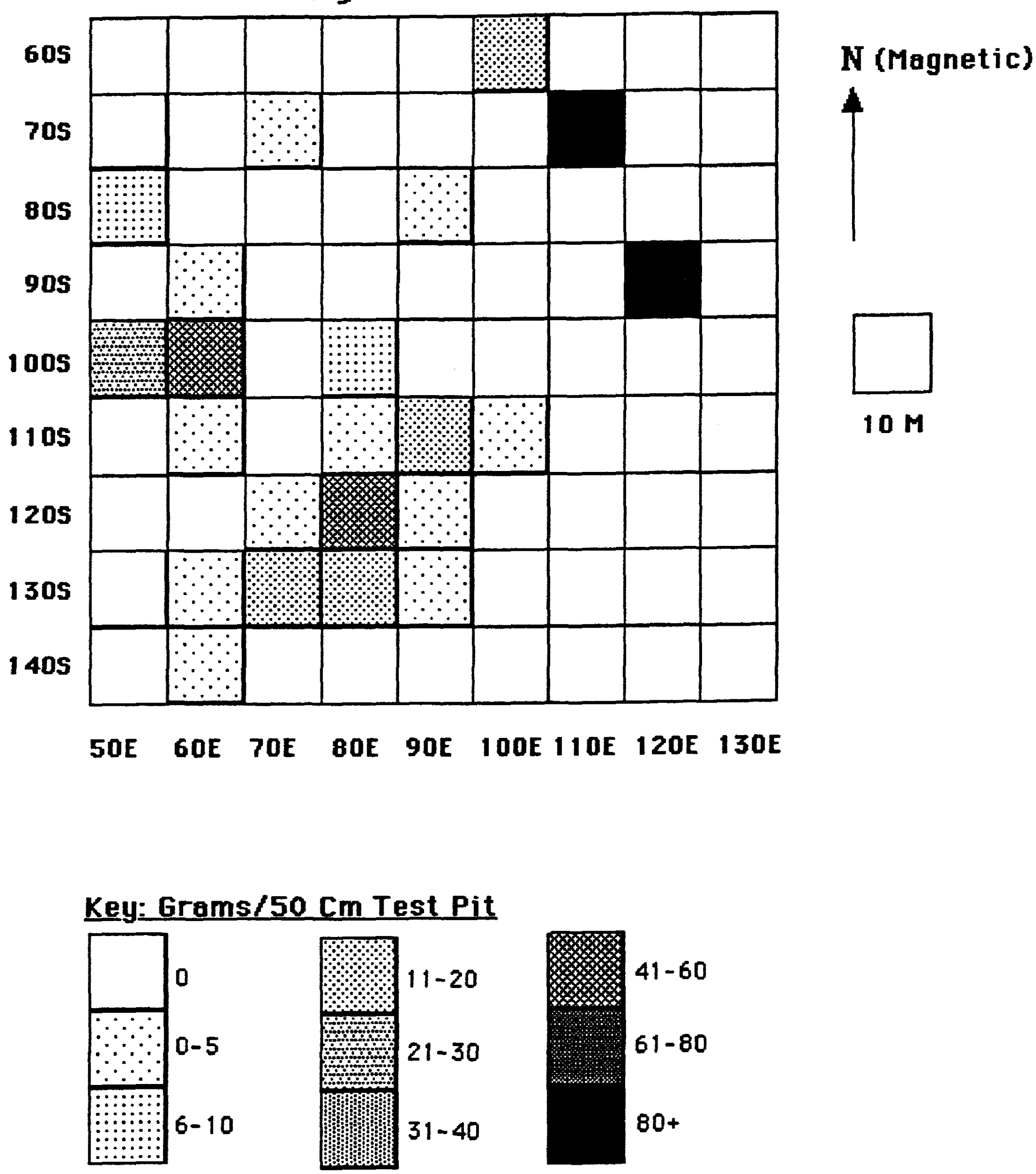


FIGURE 7.5: DENSITY (Number) OF LITHICS (Excluding FCR) PER 50 cm TEST PIT ON A 10 m. GRID

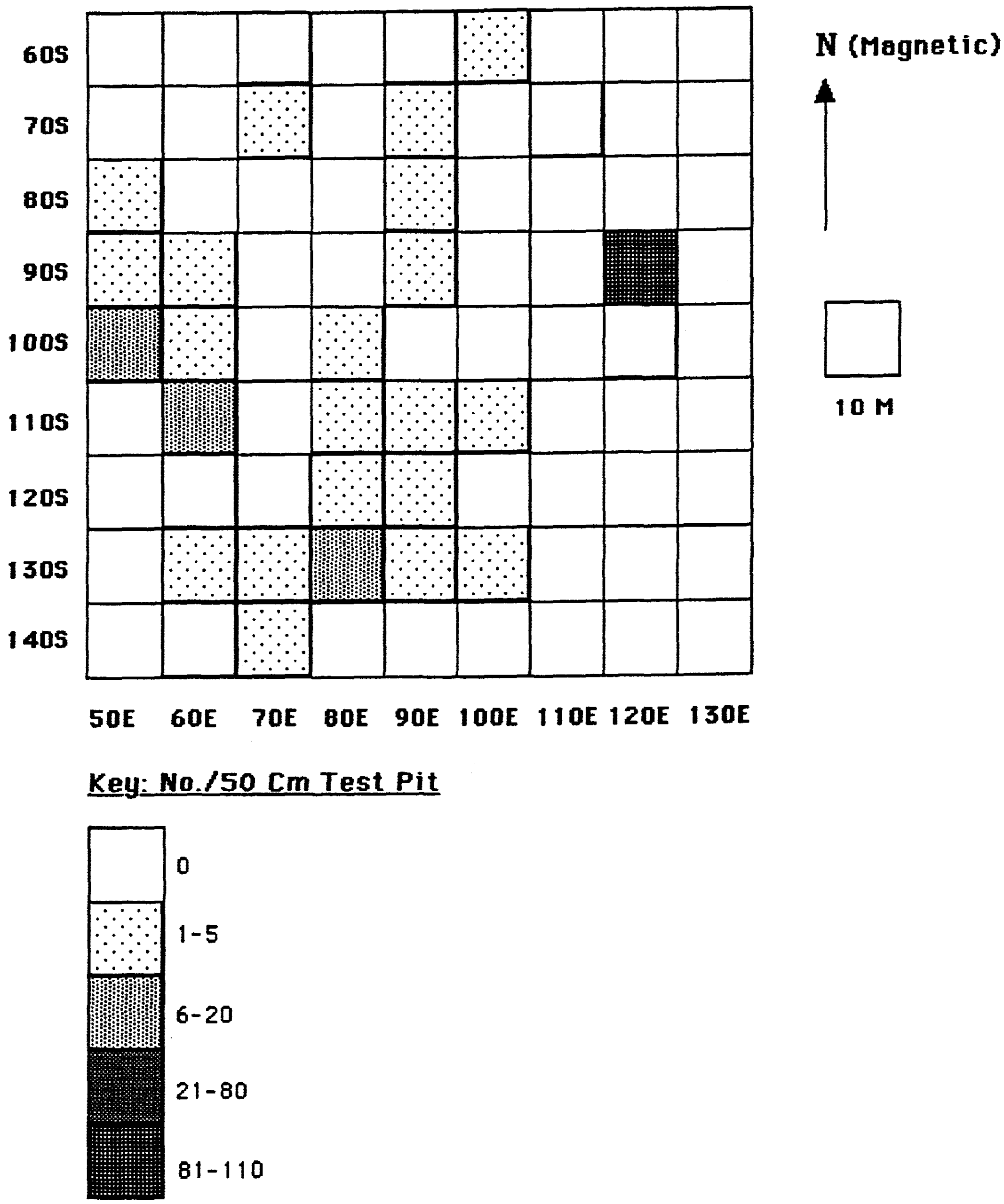


FIGURE 7.6: DENSITY (Grams) OF FAUNAL MATERIAL PER 50 cm QUAD RAMSAY EXCAVATIONS AREA A

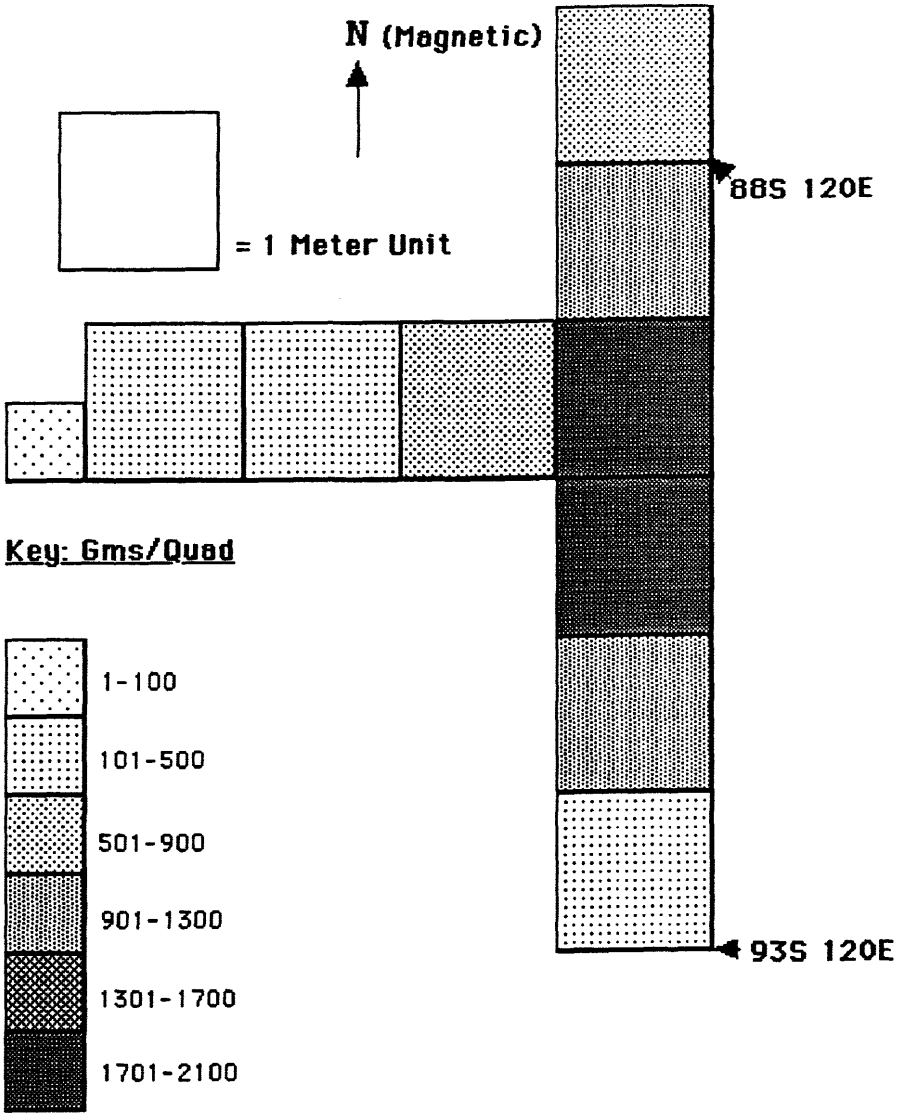


FIGURE 7.7: DENSITY (Grams) OF BURNED MATERIALS
(FCR & FAUNAL) PER 50 cm QUAD
RAMSAY EXCAVATIONS AREA A

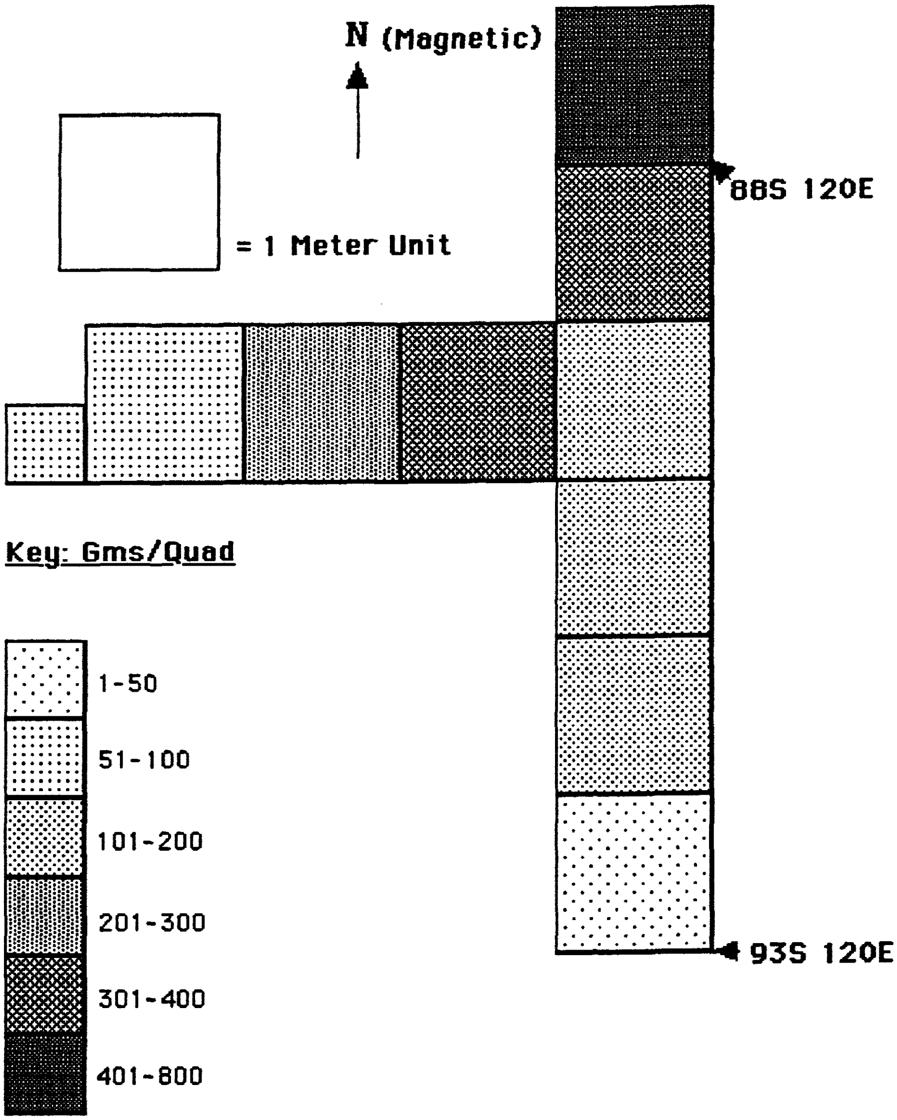


FIGURE 7.8: DENSITY (Number) OF LITHIC ITEMS
PER 50 cm QUADRANT
RAMSAY EXCAVATIONS AREA A

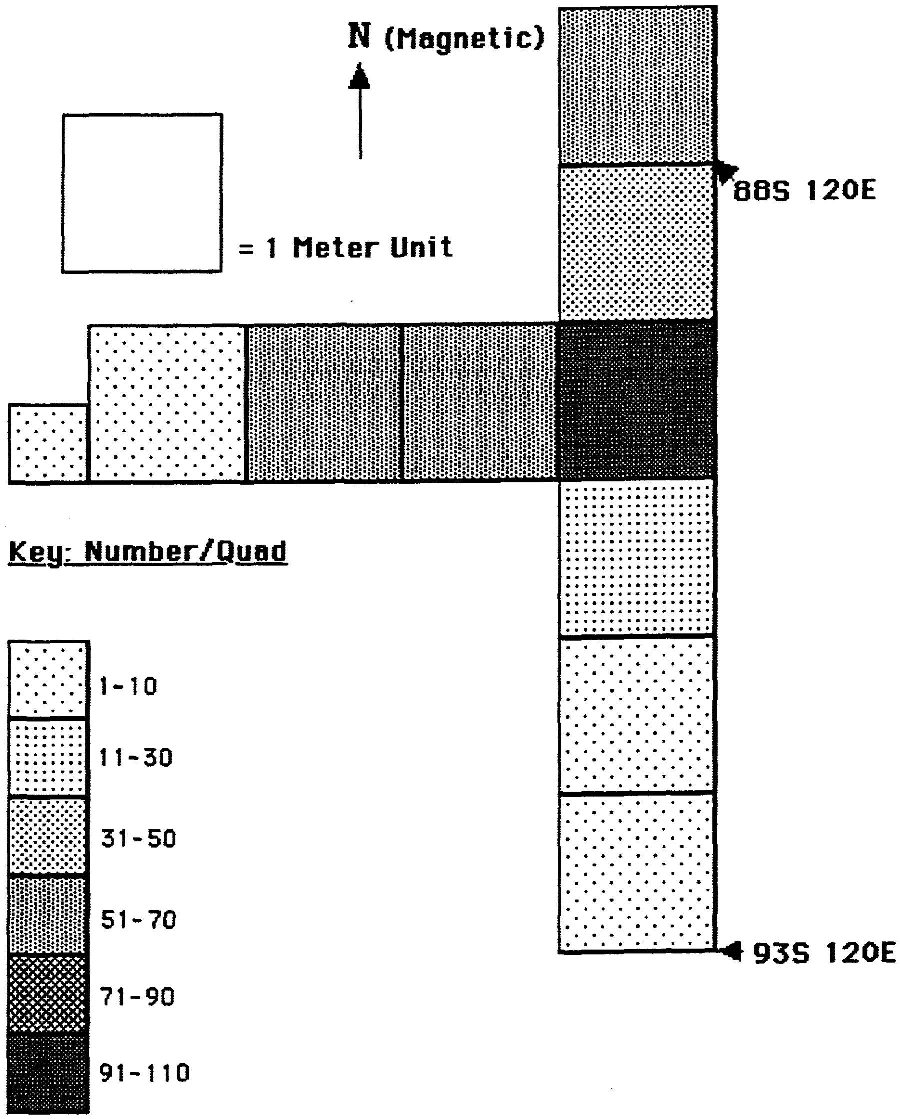
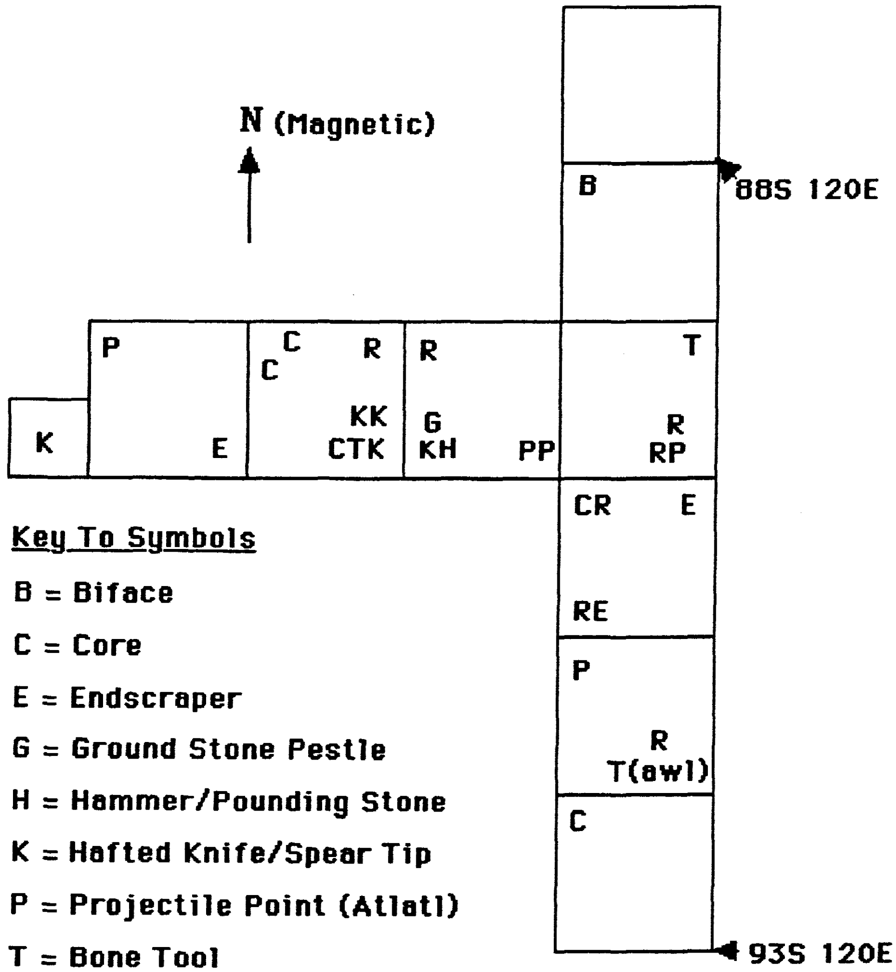


FIGURE 7.9: DISTRIBUTION OF PROJECTILE POINTS
& MISCELLANEOUS TOOLS
RAMSAY EXCAVATIONS AREA A



Key To Symbols

B = Biface

C = Core

E = Endscraper

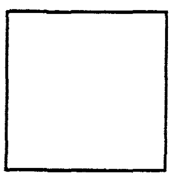
G = Ground Stone Pestle

H = Hammer/Pounding Stone

K = Hafted Knife/Spear Tip

P = Projectile Point (Atlatl)

T = Bone Tool



=1 Meter Unit

FIGURE 7.10: DENSITY (Grams) OF FAUNAL MATERIALS
PER 50 Cm QUADRANT
RAMSAY EXCAVATIONS AREA "B"

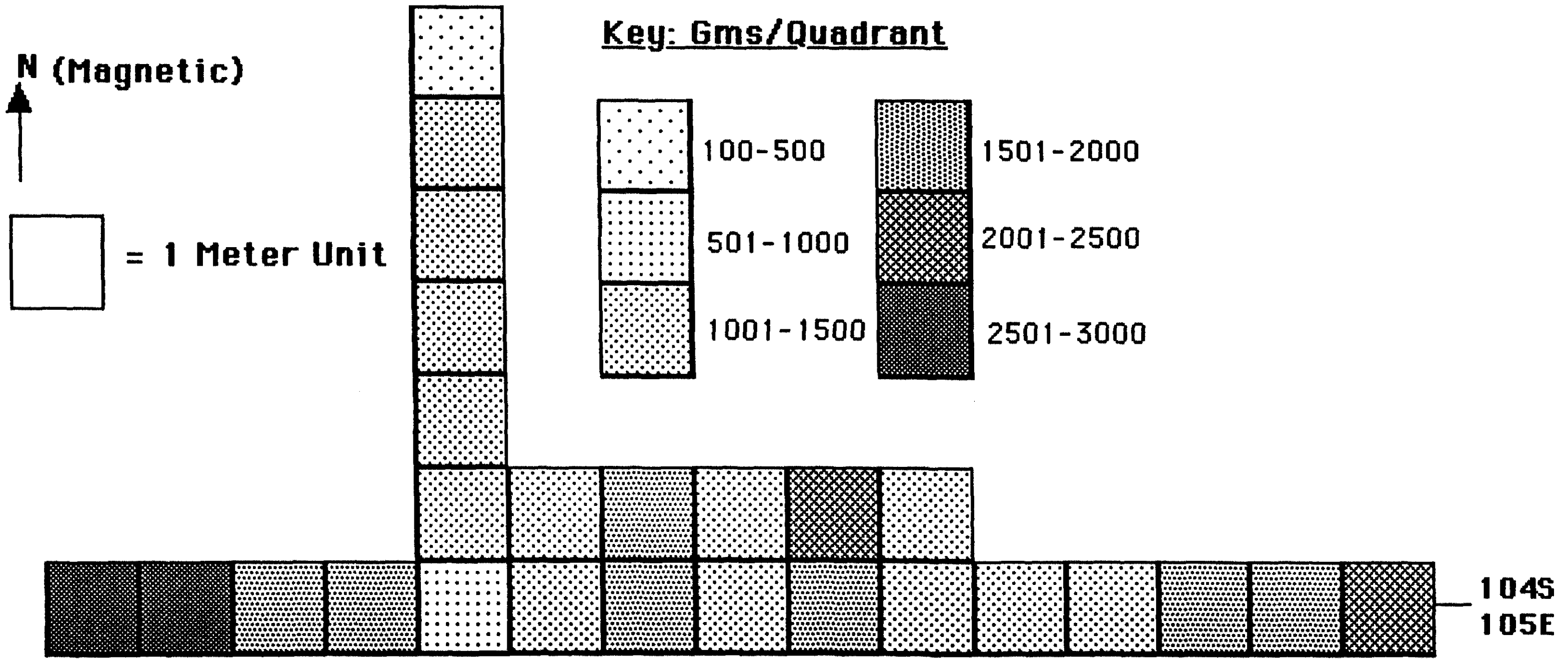


FIGURE 7.11: DENSITY (Grams) OF BURNED MATERIALS (FCR & FAUNAL) PER 50 Cm QUADRANT RAMSAY EXCAVATIONS AREA "B"

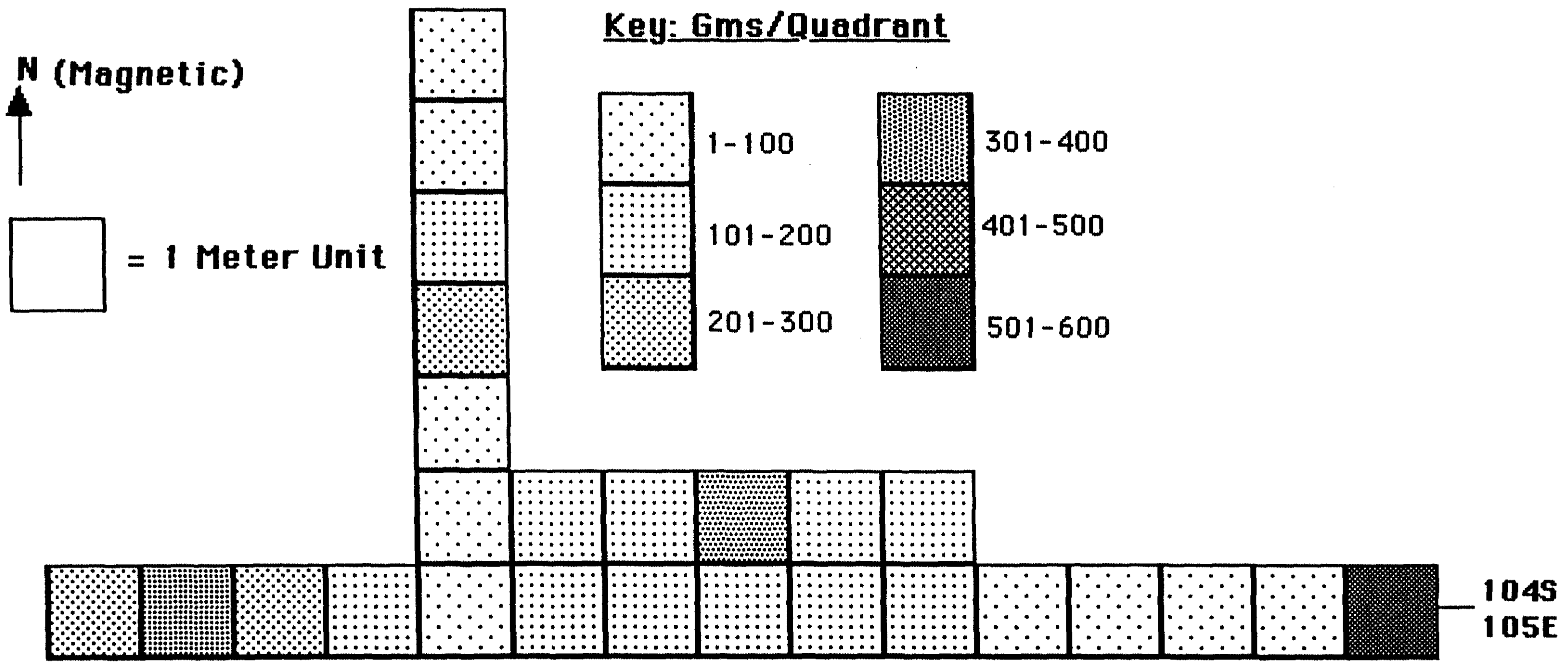


FIGURE 7.12: DENSITY (Number) OF LITHIC ITEMS
PER 50 Cm QUADRANT
RAMSAY EXCAVATIONS AREA "B"

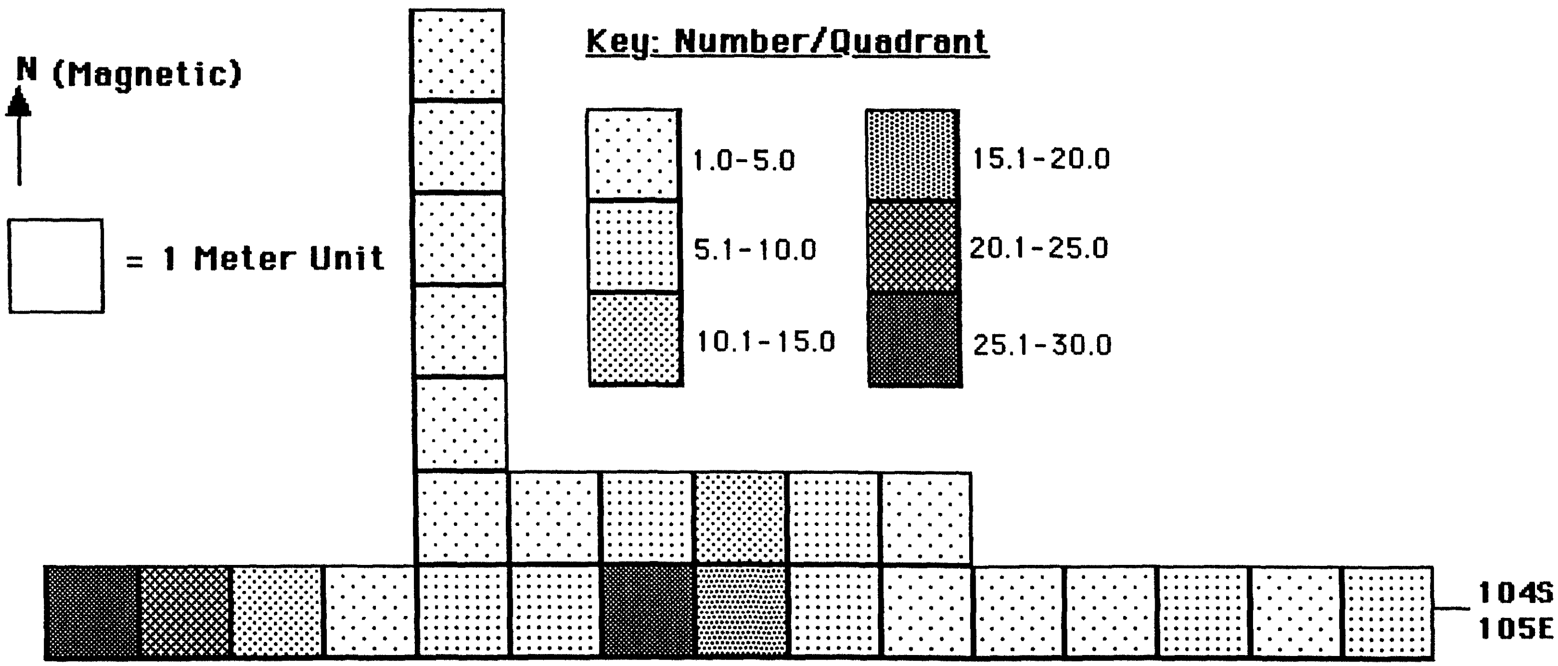


FIGURE 7.13: DISTRIBUTION OF PROJECTILE POINTS AND
MISCELLANEOUS STONE TOOLS
RAMSAY COLLECTION AREA "B"

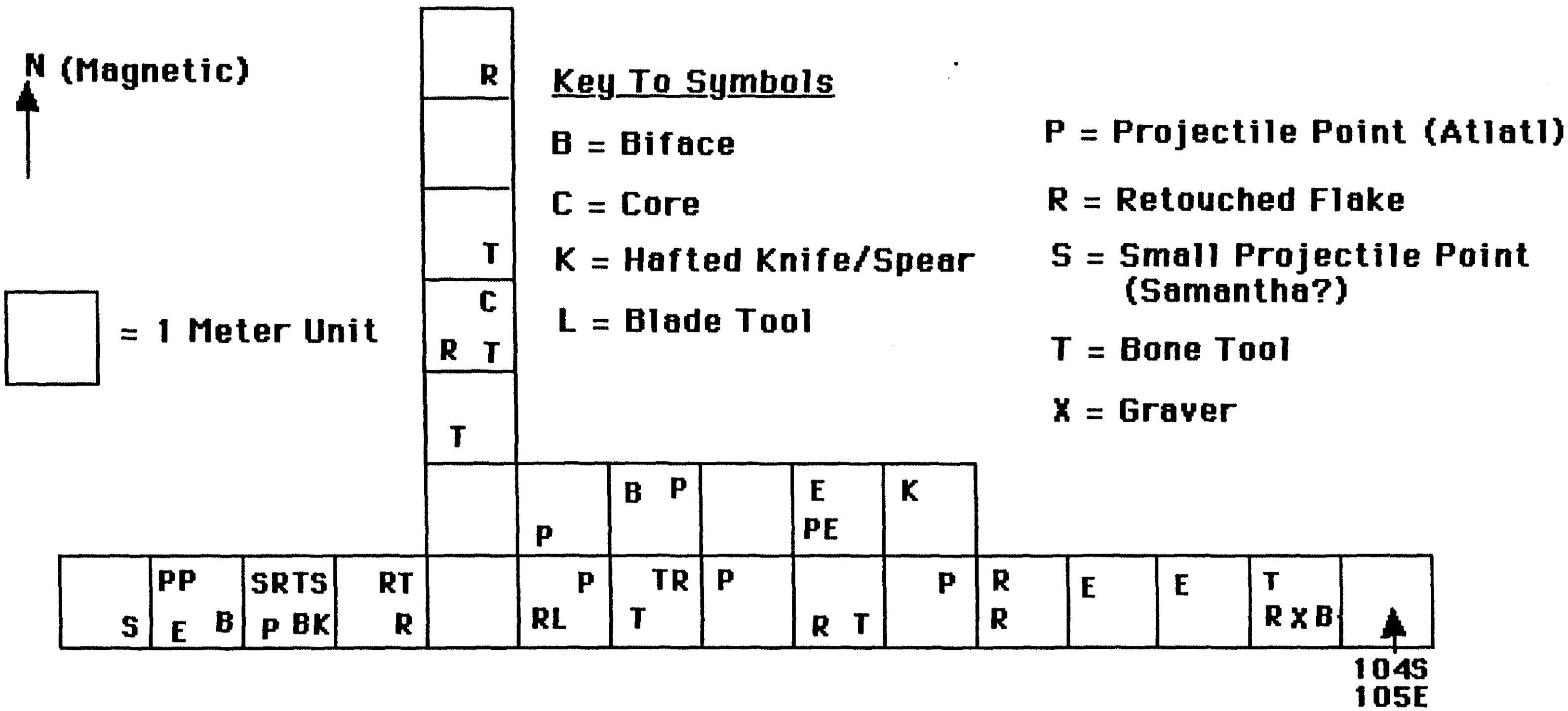


FIGURE 7.14: DENSITY (Grams) OF FAUNAL MATERIALS
PER 50 Cm QUADRANT
RAMSAY EXCAVATIONS AREA "C"

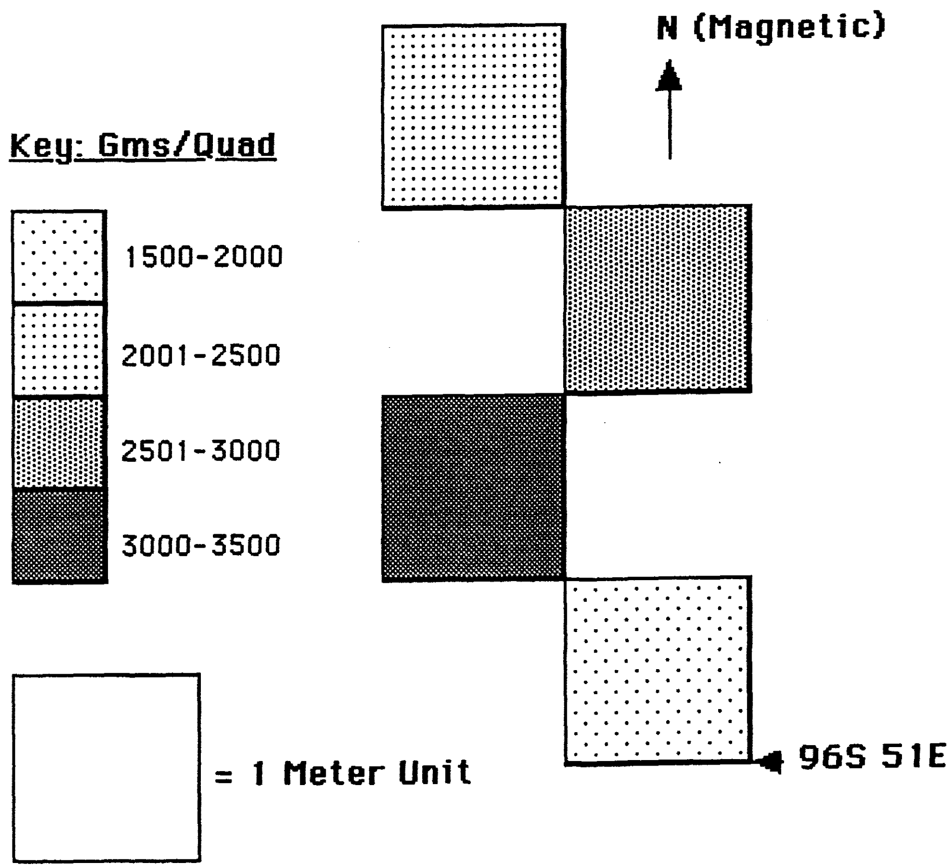


FIGURE 7.15: DENSITY (Grams) OF BURNED MATERIALS (FCR & FAUNAL) PER 50 Cm QUADRANT RAMSAY EXCAVATIONS AREA "C"

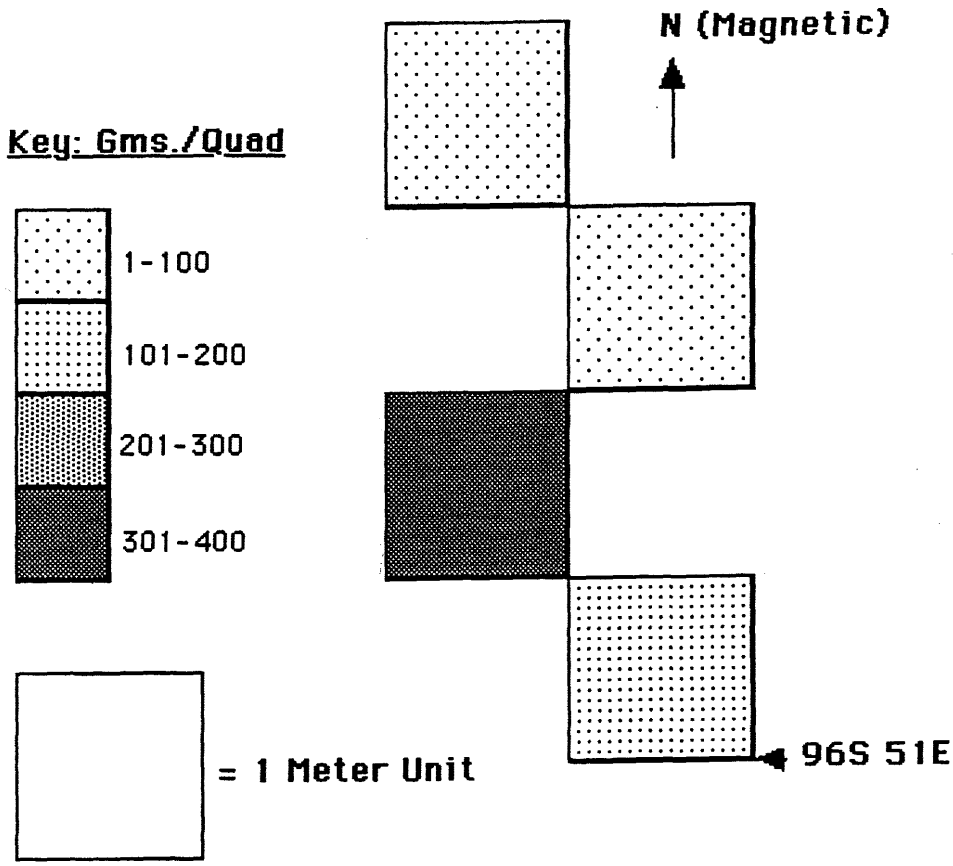


FIGURE 7.16: DENSITY (Number) OF LITHIC ITEMS
PER 50 Cm QUADRANT
RAMSAY EXCAVATIONS AREA "C"

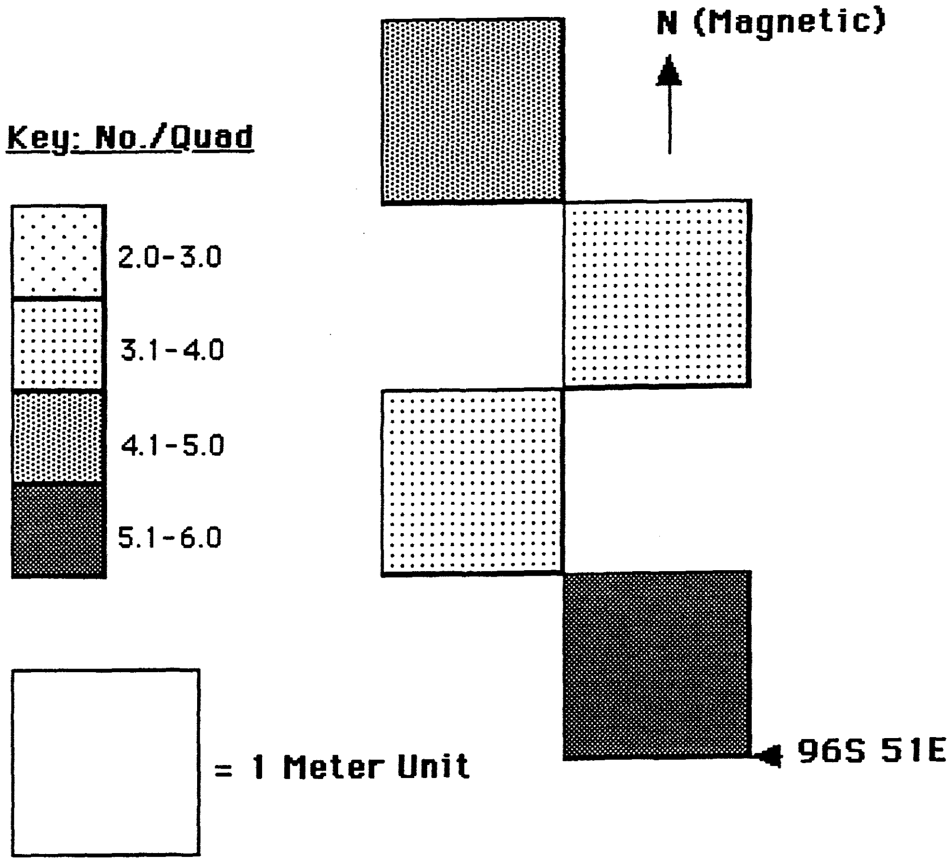


FIGURE 7.17: DISTRIBUTION OF MISCELLANEOUS TOOLS (No Projectiles Recovered) RAMSAY EXCAVATION AREA "C"

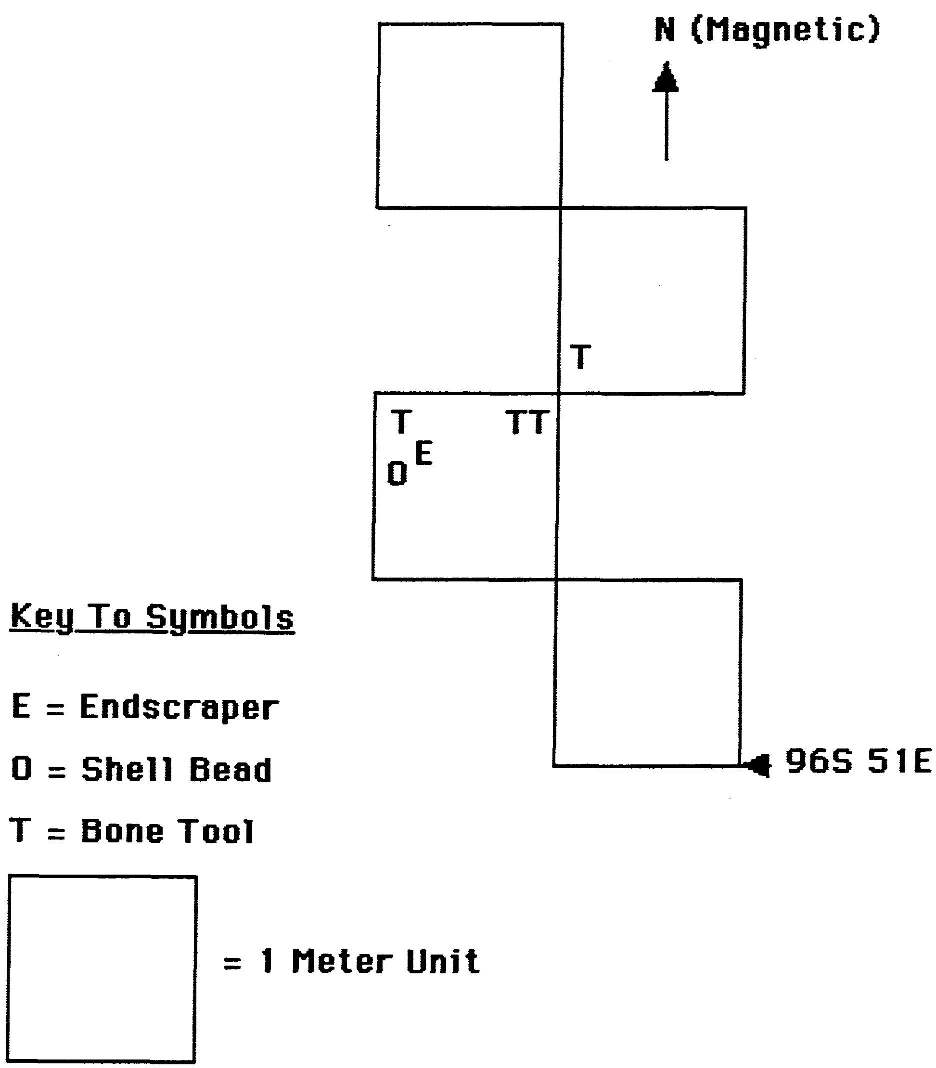


FIGURE 7.18: DISTRIBUTIONS OF FLAKES AND MICROFLAKES PHENIX SW AREA "D" EXCAVATIONS

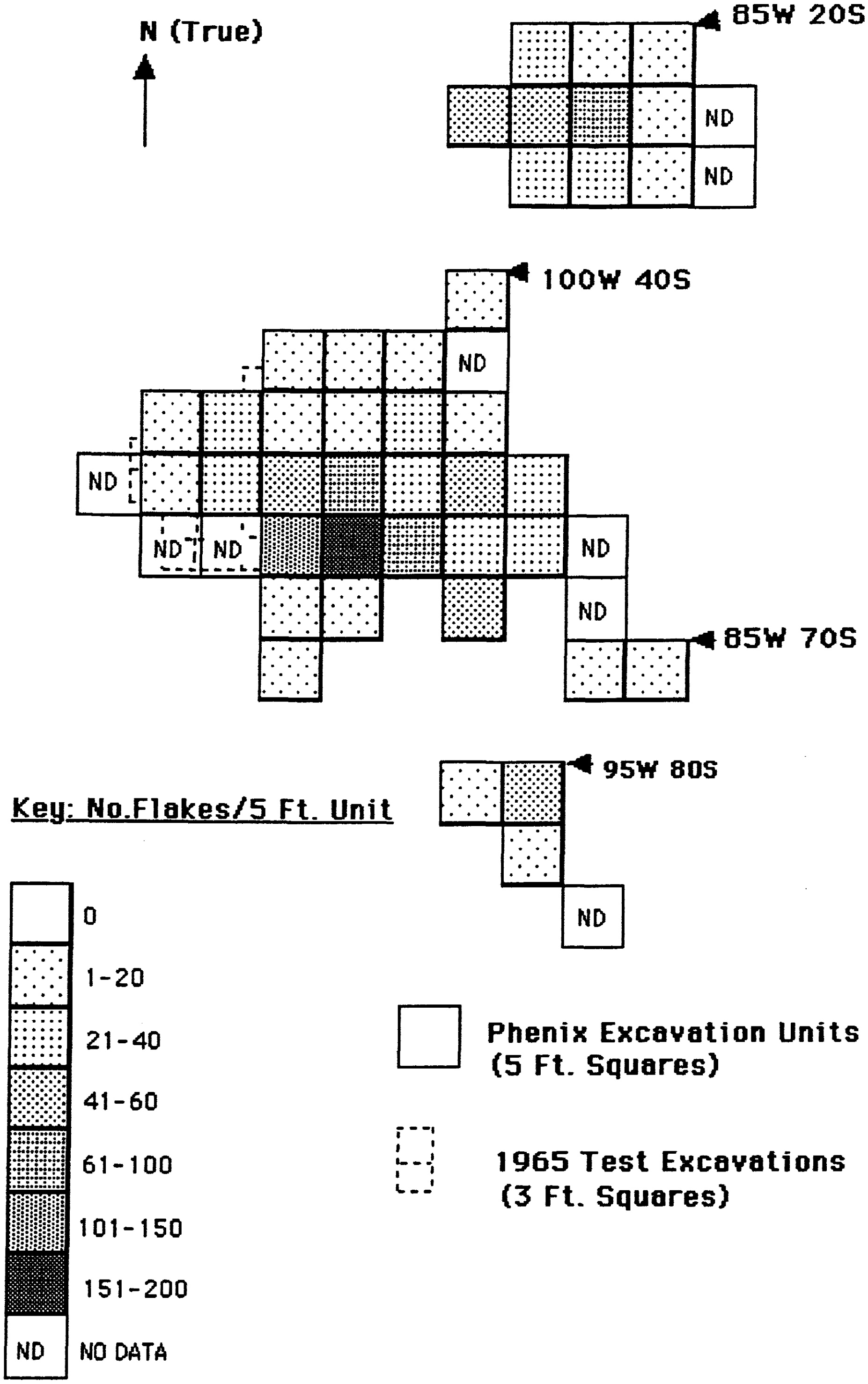


FIGURE 7.19: DISTRIBUTION OF PROJECTILE POINTS & HAFTED KNIVES/SPEARS AREA "D": SW PHENIX EXCAVATIONS

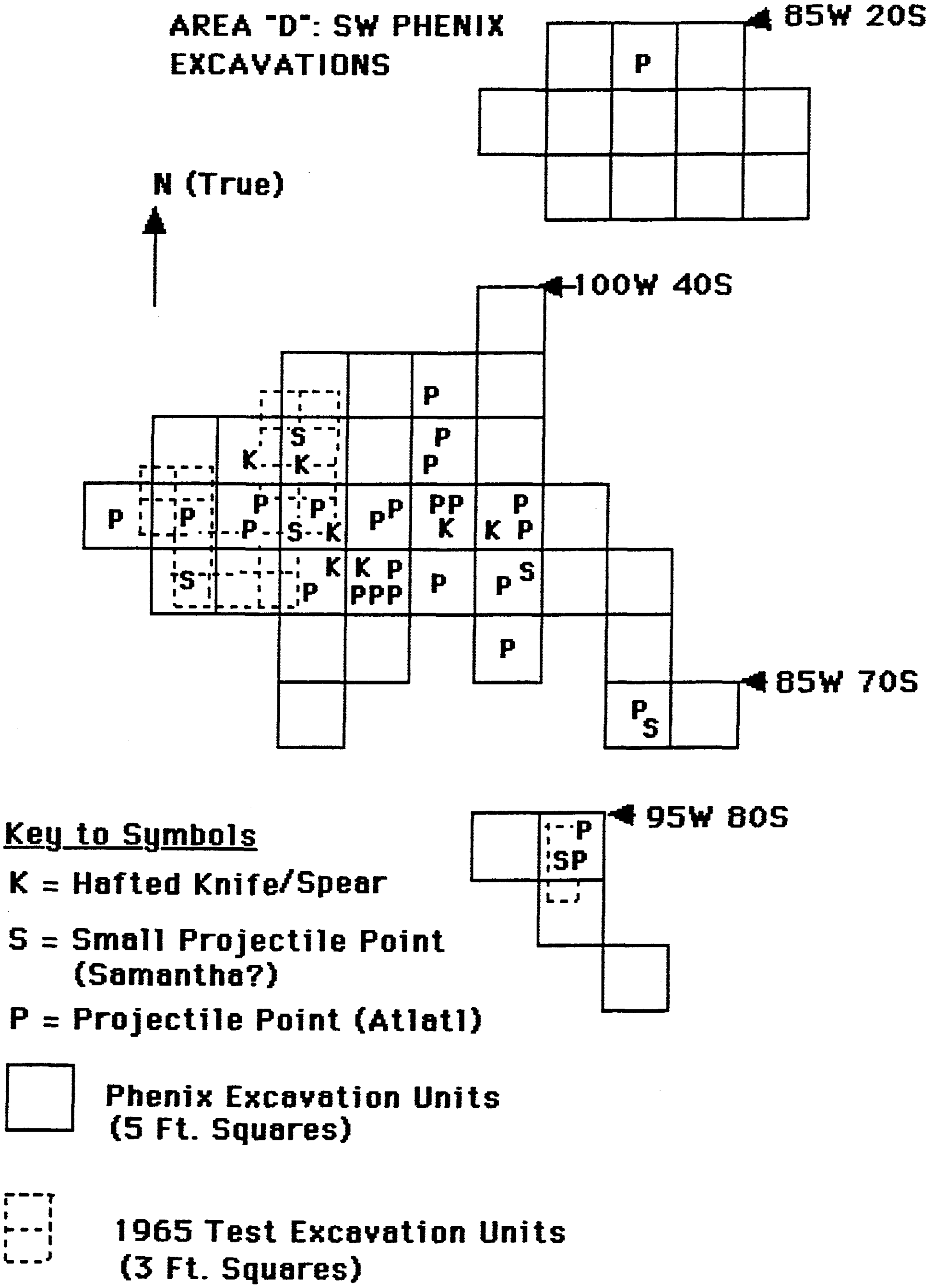


FIGURE 7.20: DISTRIBUTION OF MISCELLANEOUS TOOLS
AREA "D" SW PHENIX EXCAVATIONS

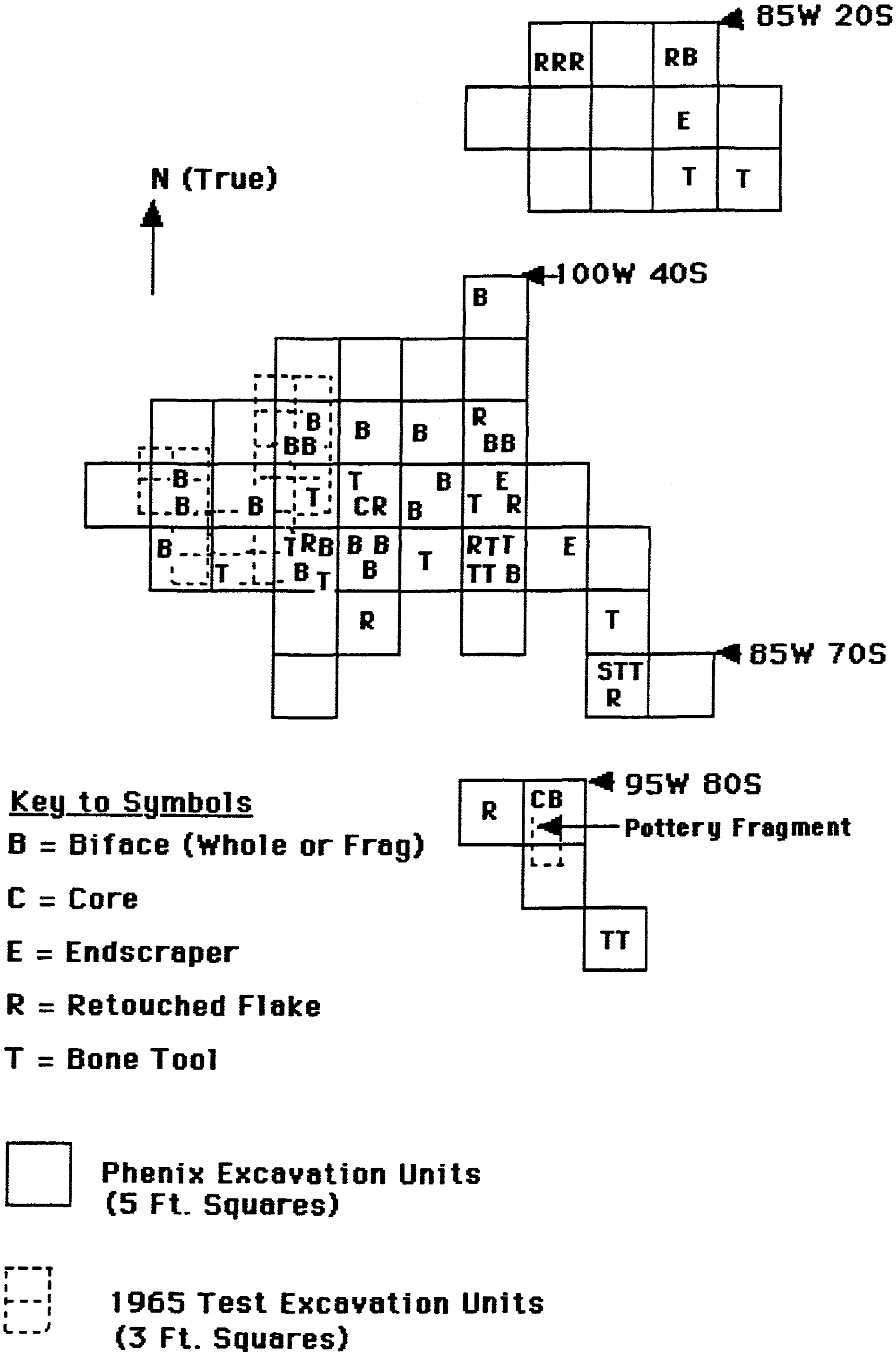


FIGURE 7.21: DISTRIBUTIONS OF FLAKES AND MICROFLAKES PHENIX AREA "E" UNITS (From Available Data)

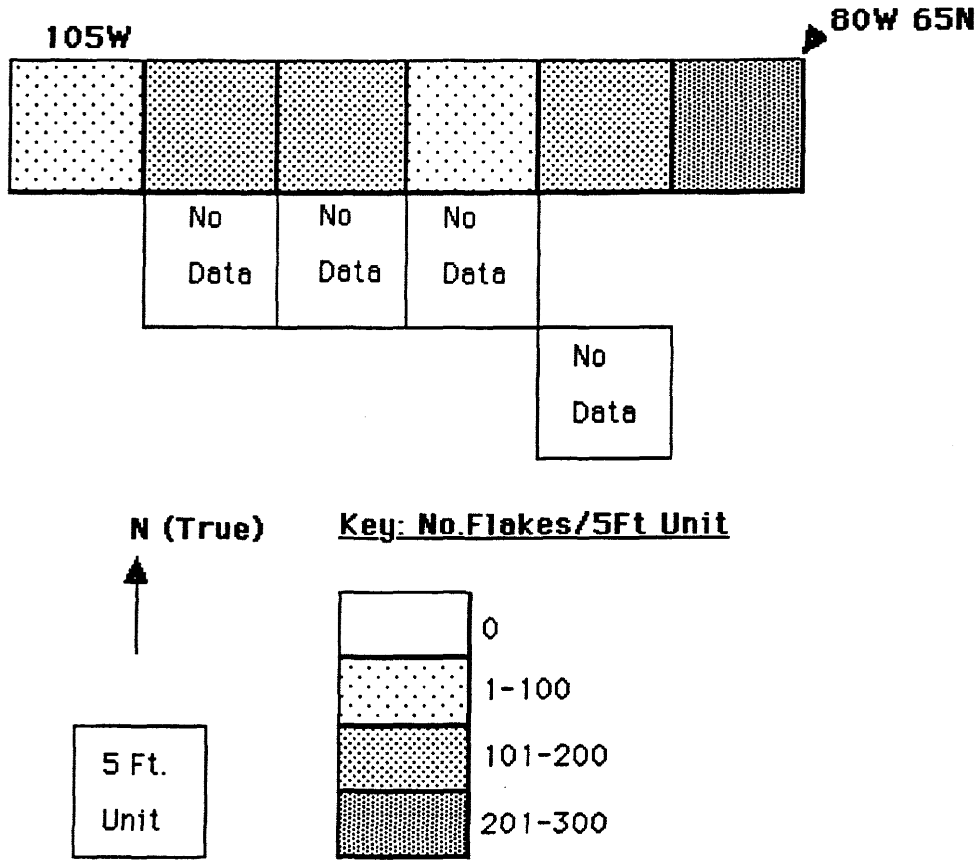


FIGURE 7.22: DISTRIBUTIONS OF BONE TOOLS, BIFACES & RETOUCHED FLAKES
AREA "E": NW PHENIX UNITS

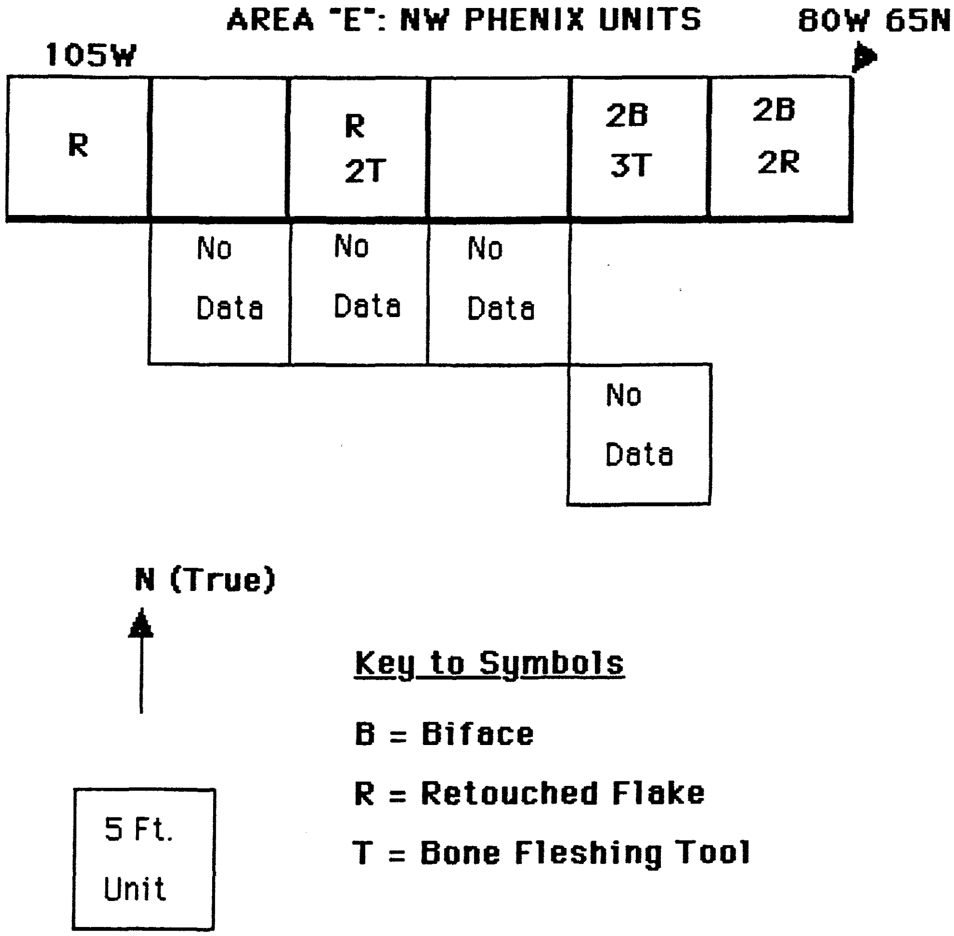
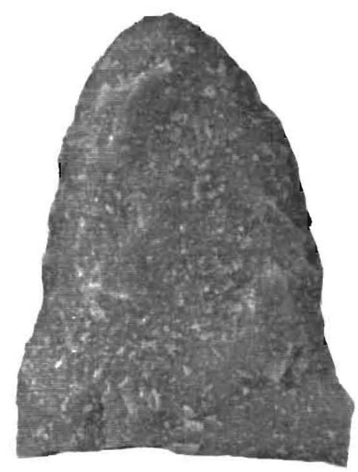


FIGURE 7.23: PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION BIFACES


474



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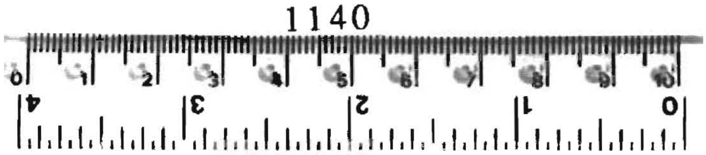
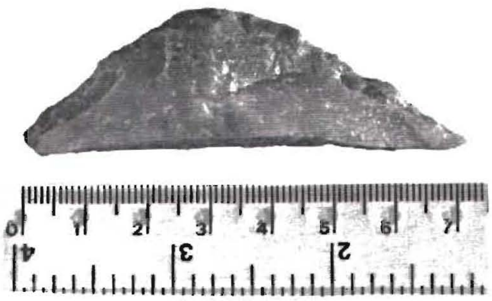



3340

FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION BIFACES

3405



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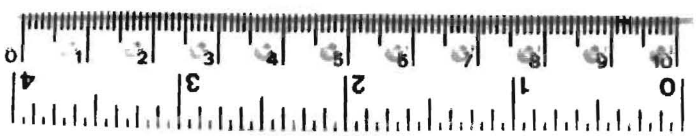


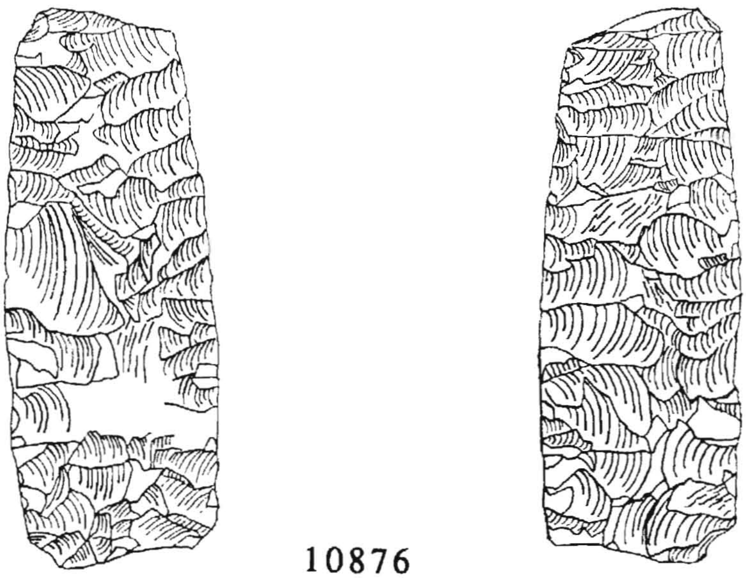
PHENIX COLLECTION BIFACES

10174

10872

FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

PHENIX COLLECTION BIFACES



10876

10879

10880

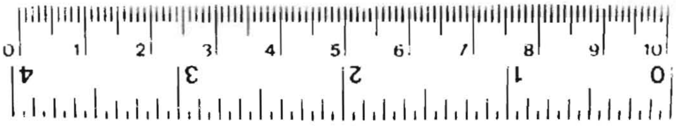


FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION UNIFACES ENDSCRAPERS SIDESCRAPERS

2842

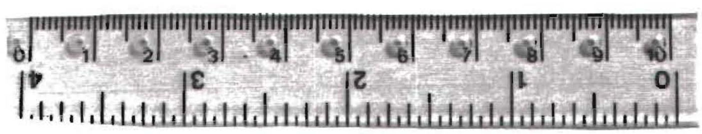
3430

5229

5441

5924

6182



PHENIX COLLECTION ENDSCRAPERS

10172

10180

10197

10416

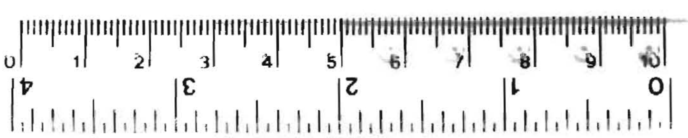


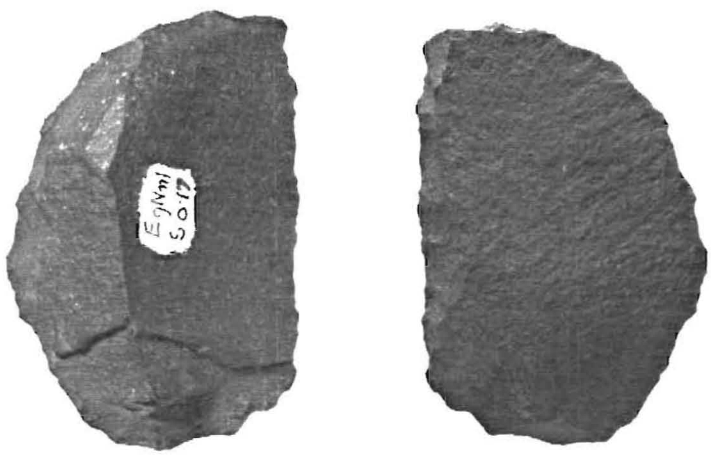
FIGURE 7.23:(Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

PHENIX COLLECTION KRF
OVATE BIFACE/KNIFE

10899

BIFACE

10922



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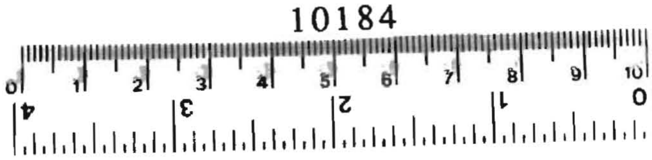


FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

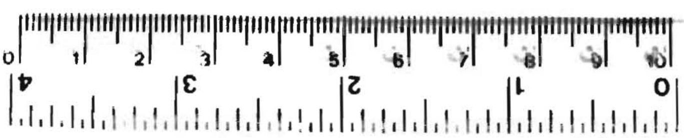
RAMSAY COLLECTION UNIFACES ENDSCRAPERS SIDESCRAPERS

244

652

978

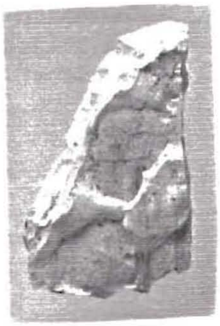
2684



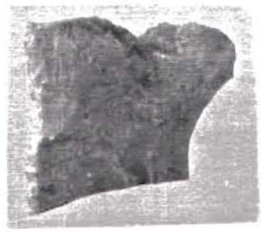
1533

FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

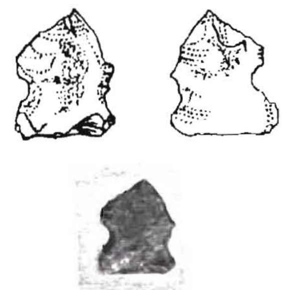
RAMSAY COLLECTION RETOUCHED FLAKES



735



802



2843

1104

6462

9199

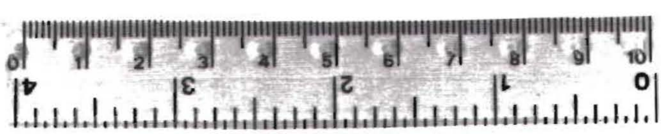
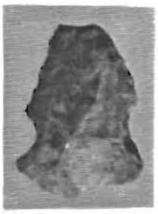


FIGURE 7.23:(Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

PHENIX COLLECTION RETOUCHED FLAKES



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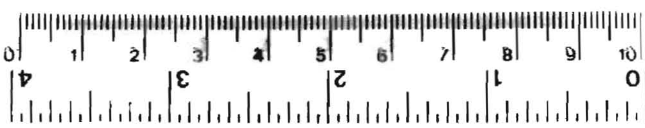
10185

10194

10360



RAMSAY COLLECTION

GRAVER TOOL

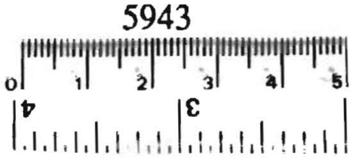
5645

BLADE-LIKE TOOL

3639

SHELL BEAD

5943



PHENIX COLLECTION POTTERY

10245

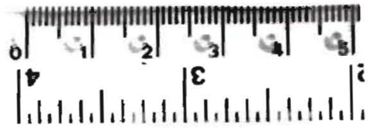
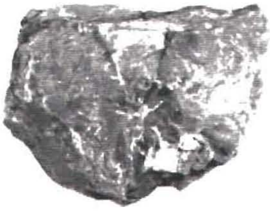


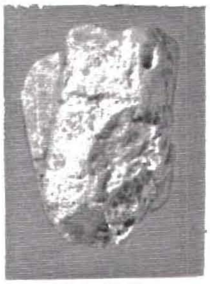
FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION CORES



1050

1869



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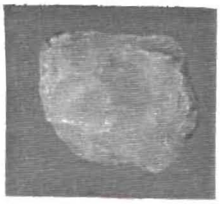
6434



6579

7209

PHENIX COLLECTION CORES

10532

10900

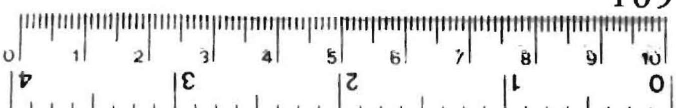


FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION BROKEN PESTLE

919

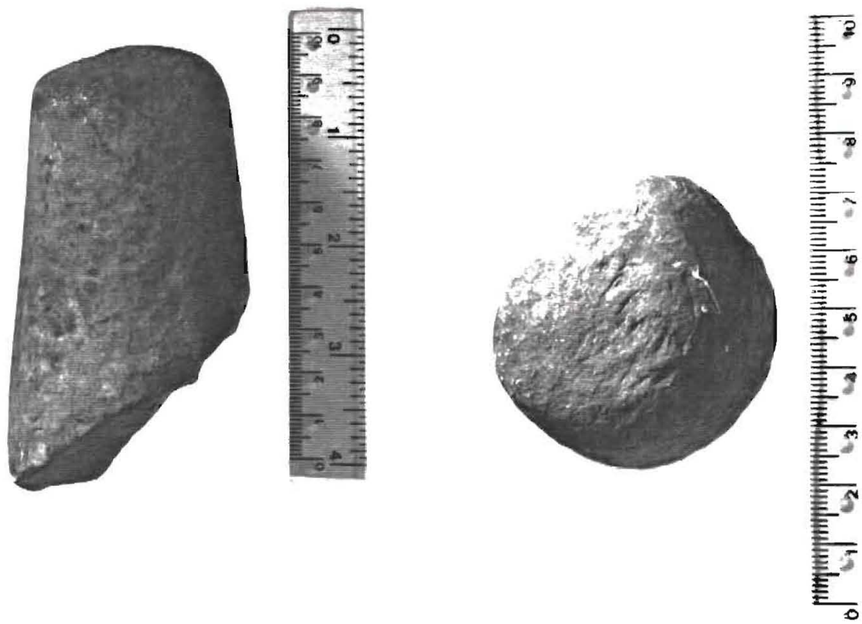


FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

RAMSAY COLLECTION POUNDING STONE

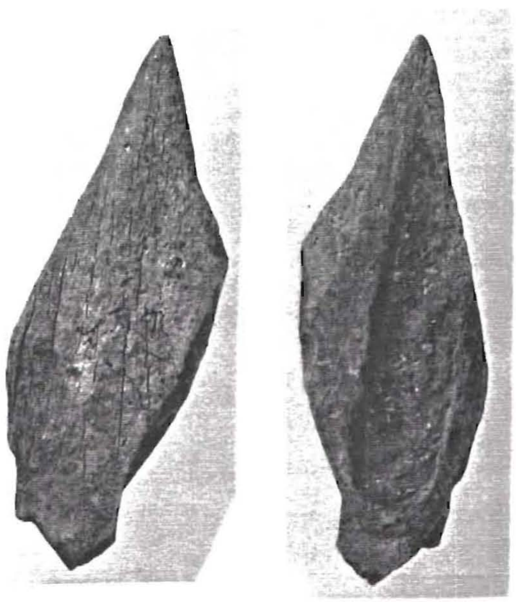
920

CHOPPER TOOL

10901

FIGURE 7.23: (Con't): PHOTOGRAPHS AND ILLUSTRATIONS OF MISCELLANEOUS TOOLS RECOVERED FROM THE MELHAGEN SITE

SELECTED BONE TOOLS FROM THE PHENIX COLLECTION



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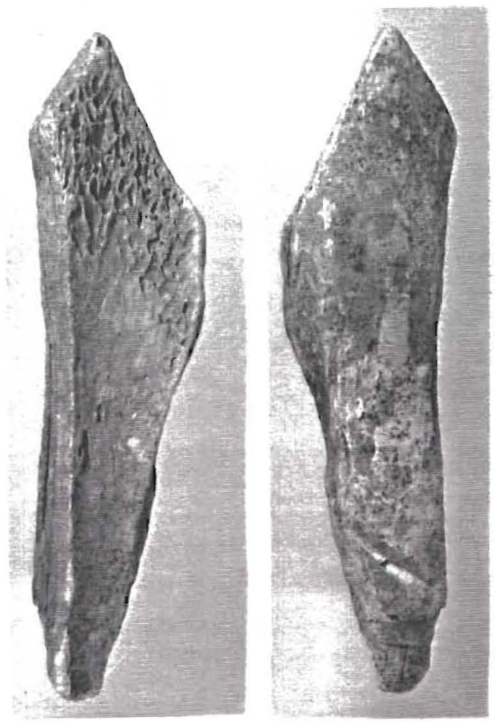

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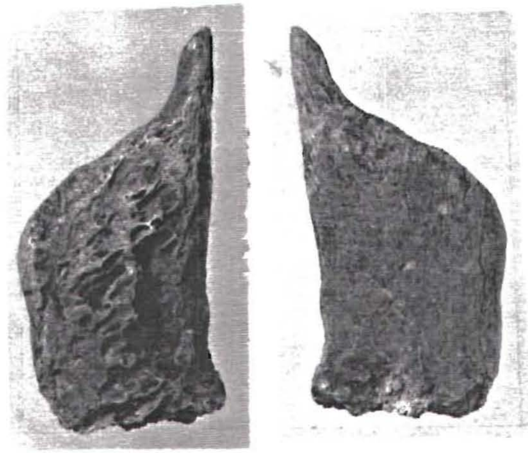

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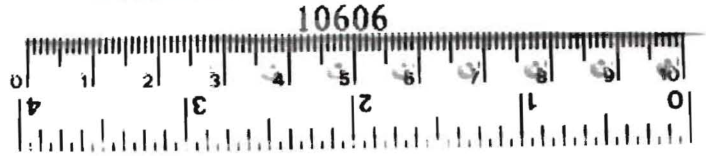

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